# A CASE STUDY OF THE CONSTITUTION OF SCHOOL MATHEMATICS FOR THE DEAF IN THREE PRIMARY SCHOOL CLASSROOMS

by

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**DECLARATION**

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

**SIGNATURE:** ___________________________ **DATE:** ____________________

## *Dedication*

This dissertation is dedicated to all deaf learners who deserve to have their educational dreams realised.

# Acknowledgements

Firstly, I would like to thank my Creator for granting me the opportunity to complete this arduous task. It has been a learning experience which has led to my personal, professional and spiritual growth.

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# Declaration

**UNIVERSITY OF CAPE TOWN**
**GRADUATE SCHOOL IN HUMANITIES**

I, RUBINA DALVI, of 58 TUSSEN ROAD, RYLANDS ESTATE, 7764 do hereby declare that I empower the University of Cape Town to produce for the purpose of research either the whole or any portion of the contents of my dissertation entitled A CASE STUDY OF THE CONSTITUTION OF SCHOOL MATHEMATICS FOR THE DEAF IN THREE PRIMARY SCHOOL CLASSROOMS in any manner whatsoever.

Signed:

__________________________

31 March 2012

Abstract

The pedagogy of deaf learners is an under-researched area in South Africa. Studies have shown that deaf learners are underachieving in South Africa, particularly in mathematics. This dissertation presents an investigation of the constitution of mathematics for a group of deaf learners in grades 4, 5 and 6. These learners were taught in sign language on the topics of *integers*, *time* and *fractions*. Four lessons were observed and video-recorded. The lessons were transcribed from sign language to English. The lesson transcripts were used as the basis for data analysis.

The study forms part of a broader framework which is aimed at investigating the constitution of mathematics in pedagogic contexts. The study was located within the framework of Bernstein's pedagogic device, at the level of the evaluative rules. The theoretical framework drew on the resources of Davis (2009b, 2010a, 2010b, 2011a, 2011b, 2011c) as well as the use of morphisms. These resources were used to produce the framework for the analysis and production of the data. The framework was used to describe the operational activity of the teachers and learners during the lessons recorded, specifically the objects made available by teachers as well as the operations employed over them. In so doing, the *what* and *how* of the constitution of mathematics within the pedagogic context of deaf learners was described.

The study concluded that integers were constituted as whole numbers with signs attached to them. Integer arithmetic was constituted as whole number arithmetic. Fractions were constituted in the form of a template using an operation-like manipulation termed *spatial distribution* through the function of counting. Exposition on computations over integers and fractions were presented to learners in the form of character distribution matrices where characters were arranged in a specific template using an exposited procedure. Teachers primarily made use of worked examples for their exposition on procedures and minimal time was spent on the exposition of mathematical principles as referenced in the mathematics encyclopaedia. Teachers did not use mathematically relevant terms in their signing.

# Table of Contents

# List of Figures

## List of Tables

# Chapter 1: Introduction

## 1.1 Rationale for the study

The quality of teaching and learning of mathematics in South African classrooms has been an area of concern within the realm of educational research. The vast majority of South African school children underachieve at primary school (Fleisch, 2008) and perform particularly poorly in mathematics (Fleisch, 2008; Reddy, Kanjee & Diedericks, 2007). Most studies are concerned with the performance of students and do not provide adequate information on the teaching and learning of mathematics presented in the classroom. To improve the quality of teaching and learning of mathematics in South African classrooms, investigative research of the nature of mathematics presented to learners is required. Specifically, investigation at the level of the constitution of mathematics within pedagogic practice will provide valuable data regarding what is realised as mathematical knowledge in classrooms. Studies regarding the constitution of mathematics within various contexts (Arendse, 2011; Basbozkurt, 2010; Chitsike, 2011a, 2011b; Davis, 2011a, 2011b, 2011c, 2010a, 2010b, 2010c; Davis & Johnson, 2007, 2008; Gripper, 2011a, 2011b; Jaffer, 2009, 2010a, 2010b; Mackay, 2009, 2010; Roberts, 2009, 2010) have been conducted in order to gain insight into the computational activity present within the pedagogic practices of teachers and learners. Studies on the constitution of mathematics are concerned with what comes to be constituted as mathematics within various pedagogic contexts and how this constitution comes to be realised. In so doing, the characteristics of the mathematics presented within the pedagogy of specific contexts are highlighted and important conclusions can be drawn regarding the quality of teaching and learning of mathematics operative within these pedagogic contexts. Ultimately, the aim of these studies is to improve the quality of mathematics pedagogy within the contexts of South African classrooms.

The focus of the current study is to explore the teaching and learning of mathematics within a particular pedagogic context—that of deaf[1] children. In the education of deaf children, there

[1] According to the Deaf Federation of South Africa (DeafSA), the term Deaf (with a capital D) refers to those people who use Sign Language as their preferred means of communication and who perceive themselves as being part of a distinct cultural and linguistic group (Deaf Federation of South Africa, 2006). Deaf culture is thus based on the belief of deaf people as belonging to a community bound by the experience of deafness and the use of a signed language (Aarons & Akach, 2002). The term "deaf" is an adjective which refers to a hearing loss from a medical or audiological perspective (Deaf Federation of South Africa, 2006). Based on these two distinct perspectives on deafness, it is possible for a person to be 'deaf' without being 'Deaf'. While these distinctions are important, the use of the term "Deaf" as a description of a cultural group minimises the complexity of membership in the deaf community (Reagan, Penn & Ogilvy, 2006). For the purposes of the current study, the term "deaf" will be used to refer to persons with any degree of hearing impairment regardless of membership in the deaf community. For a more detailed explanation on the perspectives of deafness, see Appendix A.

are many issues at policy and curriculum level that impact on the teaching and learning that occurs in the classroom. Those who are involved in this sector of education—from policy-makers to curriculum advisors to the educators in the classroom—find themselves in a unique situation in the education of deaf children. The situation within the South African context is particularly dire due to our history of segregation and inequality. For a detailed explanation of the international and national history of education for the deaf as well as the different modes of communication emerging from the historical contexts, see Appendix B.

In order to improve the quality of education for these children, thorough research is needed at classroom level. Research into the pedagogic practices of teachers will provide useful evidence of the mathematics knowledge that is made available to learners. By analysing teacher practices, the quality of education can be improved. The focus of this study is to explore *what* comes to be constituted as mathematics in classrooms of a particular group of deaf students and *how* this constitution comes to be realised.

### 1.2 Rationale for the particular context

Having worked as an education therapist in the field of deaf education for almost seven years, I experienced first-hand the hardships faced by teachers and learners. The many issues related to deaf children and their language acquisition has long been a subject of debate and controversy. Internationally, the language modality to be used with these children has fluctuated from one form to the other, from various manual forms to oralism, back to manual communication and so forth (Coryell & Holcomb, 1997). The shifts in language use have varied over the years and have resulted in many programmes advocating the implementation of specific forms of language use for this population of children (See Appendix B). However, there is no single communication form which is considered as being the most appropriate for all deaf or hearing impaired children.

On an international level, deaf children’s achievement at school has been widely researched. The literature review will show that the main findings of most studies are that deaf children generally underachieve academically and perform at lower levels than their hearing counterparts in schooling in general and mathematics particularly (Nunes & Moreno, 2002; Traxler, 2000). The main areas of research emerging from the literature are deaf children’s poor performance in mathematics as well as the areas of weaknesses that these children seem to experience. Their performance is often compared to that of hearing children with deaf children producing poor results in mathematics. Some reasons cited for their underachievement generally and in mathematics specifically are difficulties with language and reading comprehension (Kelly & Mousley, 2001; Lang & Pagliaro, 2007; Nunes & Moreno, 2002). While the research points at areas of concern for these children as well as some strategies that seem to assist their development in certain areas of mathematics, few studies are concerned with the actual pedagogy operational in classrooms for the deaf. A search of the literature did not yield any studies exploring the constitution of mathematics within the pedagogic contexts for deaf children, yet the mathematics development of deaf children seems to be an important issue in the deaf literature. The literature search has shown that the extended focus of mathematics pedagogy for deaf children is an under-researched area. It is through pedagogy that learners are able to access the resources that lead to mathematics learning. By focussing on the pedagogy operational within the classrooms of deaf children, the teaching and learning process can be described. The challenges faced by teachers and learners can be explicated. In so doing, the quality of teaching and learning may improve.

In South Africa, many of the language trends adopted in communicative and education contexts internationally were mirrored. However, these trends were largely influenced by the political context of the country. The political scene during the apartheid era resulted in disparities in the education of deaf children which were based on racial grounds. Similar to the international scene, deaf children in South African schools are also underachieving (Department of Education, 2003) and are leaving school functionally illiterate (Deaf Federation of South Africa, 2006; Storbeck, 2005). However, research conducted in South African deaf educational contexts is minimal and does not provide a clear picture of what deaf children are being taught and how they are learning. This study attempts to provide insight into the pedagogy operative in particular classrooms where deaf children are being taught mathematics.

In order to fully comprehend the situation in which teachers and deaf learners find themselves, the educational issues—particularly language use— pertaining to deafness need to be outlined and explicated. The current scenario is based on the historical context of the country, which has played a role in the language used in the current research context. Education for deaf children is a sector of special needs education which has received considerable government attention since 1994. The following section provides an explanation of the educational policy and curriculum pertaining to the education of deaf children as their effects on pedagogic practice. The core issues regarding the challenges faced by educators and learners will be detailed.

### 1.3 Educational policy, curriculum and classroom practice

The study will be considered at three levels, namely educational policy, curriculum and classroom practice. The curriculum emerges from the policy and determines what pedagogic practices occur at classroom level. The relevant aspects from the policy on special needs education will be outlined. Subsequently, the curriculum as it pertains to deaf children will be explained. The impact of the curriculum on teaching and learning of deaf children will be explained.

#### 1.3.1 The education policy

The Education White Paper 6 (Department of Education, 2001) is the current policy document pertaining to children with special needs in South Africa. Appendix C provides a detailed description of the background to the policy. The tenets of this policy document are based on the values of human dignity, the achievement of equality and the advancement of human rights and freedoms as entrenched by the South African Constitution (Constitutional Assembly of the Republic of South Africa, 1996) (Section 1a, p. 1243). The Constitution further promotes the principle of equality where all citizens have equal rights and freedoms and shall not be discriminated against in any way, including race, language and disability among others (Section 9(1) p.1247). The principles of the South African Constitution (1996) provide the foundations on which education for children with special needs is based. The main premise of education for these children is based on the conceptual framework of an inclusive model which concurs with international trends and guidelines (Aarons & Akach, 1999). The adoption of the inclusive model also relates to the South African political climate at the time and the African National Congress (ANC) policies of access and equity. For a more detailed explanation on an Inclusive Model of education, see Appendix D.1.

#### 1.3.1.1 The issue of South African Sign Language (SASL)

The South African Constitution states that: “Everyone has the right to receive education in the official language or language of their choice in public educational institutions where that education is reasonably practicable” (Constitutional Assembly of the Republic of South Africa, 1996) (Section 29 (2)). Although South African Sign Language (SASL) is not one of the official languages of South Africa, the South African Constitution declares it as one of the languages of South Africa and that the adequate conditions for its continued development and use must be created (Constitutional Assembly of the Republic of South Africa, 1996) (Section 6 (5)(a)(iii)). According to the South African Schools Act (1996), Sign Language is recognised as an official language for the purpose of education ((Parliament of the Republic of South Africa, 1996) (Section 6(4)). The statements from the various policies imply that for the purposes of education of the deaf, SASL may be considered as an official language and may be used as the medium of instruction in schools. These sentiments are echoed in the Language in Education Policy (1997) which sees policy for language development as being “part of a continuous process by which policy for language in education is being developed as part of a national language plan encompassing all sectors of society, including the deaf community” (Section 5 (2): 1). The various policy documents have recognised South African Sign Language as a language used by deaf people and that its use should be promoted as an official language of instruction in schools for the deaf. Deaf children thus have a constitutional right to be educated in sign language. For a more detailed description of the features of sign language, see Appendix E.

The major barrier experienced by deaf children in accessing the curriculum is that of language. The policy advocates that the medium of learning and teaching should be free of discrimination and should allow access to education for all learners (Department of Education, 2001). The deaf community was particularly affected by discrimination as sign language was not previously promoted in schools for the deaf thereby denying deaf children access to education (Department of Education, 1997). The current status of SASL as the medium of teaching and learning for deaf children implies that teachers need to be proficient in SASL. However, in practice, this is not the case as teachers are not required to have sign language training prior to working in a school for the deaf (Storbeck, 2005). A survey indicated that only 14% of educators in schools for the Deaf were able to use Sign Language proficiently (DeafSA, 2006). Research is needed to determine the current levels of proficiency of teachers of the deaf. Deaf children are thus still disadvantaged in terms of gaining access to the curriculum through the medium of SASL.

The NCESS and NCSNET Report (1997) advocated that SASL be included in the Language, Literacy and Communication Learning Area. The implication is that Sign Language should be taught as a learning area. The issues related to SASL as a learning area will be discussed in section 1.3.2.1.

### 1.3.2 The curriculum

The National Curriculum Statement (NCS) became official government policy in 2002 and was a revised version of Curriculum 2005 (C2005). The NCS applied to all children in grades R to 9 and was a statement of what children should achieve in terms of learning outcomes and assessment standards by the end of each grade (Department of Education, 2002a).

The education policy advocates that all children, including deaf children, have access to the same curriculum— synonymous with a “one cap fits all approach” (Powers, 2002: 232). The assumption is that the same curriculum is suitable for all children and is underpinned by the notion of equality. The policy and curriculum project an egalitarian impulse however concurrently promotes the ideology that children should be accommodated in terms of their individual and diverse learning needs. Consequently, there are implications for the implementation of the curriculum.

#### 1.3.2.1 Provision of specialised South African Sign Language vocabulary

In the education of the deaf, there are complications in terms of the language to be used to present the curriculum. Deaf children need to have the curriculum presented in sign language; however the Department of Education does not provide teachers with a standardised sign language equivalent of the specialised terms or vocabulary needed for different subjects. At the time of the study, teachers were not required to have training in SASL when teaching at a school for the deaf. For teachers, there were thus difficulties in the implementation of the curriculum at the level of the language. Teachers may therefore have been inventing their own signs or may have been omitting certain specialised terms from the curriculum, as they did not know the sign which represented the term. Access to the curriculum continues to be an issue for deaf children due to a lack of standardised signs needed to represent specialised terms.

Fingerspelling is often used in schools for the deaf to bridge the gap between a spoken language and sign language. Fingerspelling is a manual representation of the letters of the writing system and augments sign language. The manual alphabet has a specific handshape for each letter of the alphabet as shown in Figure 1.1 and is used in sign language when individual words need to be spelled. Figure 1.1 shows the fingerspelling used at the pedagogic site of the study.


**Figure 1.1 The manual alphabet** (Thibologa Sign Language Institute, 2007)

#### 1.3.2.2 Recontextualising of the curriculum

In order to fill the gap left by the Education Department, external agencies are often involved in recontextualising the curriculum. An example of how the National Curriculum (C2005) has been recontextualised for deaf children is given below:

**Learning Area: <u>LANGUAGES</u>**

Home (First) Language for the deaf learner is South African Sign Language (SASL) and the Additional Language is English or Afrikaans.

**<u>L1 Learning Outcome 1: *Visual* Listening</u>**

The learner will be able to <u>visually</u> listen for information and enjoyment and respond appropriately and critically in a wide range of situations.

**L2 Learning Outcome 2: *Signing***

The learner will be able to communicate confidently and effectively in Sign Language in a wide range of situations.

**L3 Learning Outcome 3: Reading and Viewing**

The learner will be able to read and view for information and enjoyment, and respond critically to the aesthetic, cultural and emotional values in texts.

**L4 Learning Outcome 4: Writing**

The learner will be able to write different kinds of factual and imaginative texts for a wide range of purposes. This applies to a simplified gloss of SASL and written English or Afrikaans

**L5 Learning Outcome 5: Thinking and reasoning**

The learner will be able to use language to think and reason, and access, process and use information for learning.

**L6 Learning Outcome 6: Language Structure and Use**

The learner will know and be able to use the parameters (non-manual features, handshapes, palm orientation, movement and location), vocabulary and grammar of the language to create and interpret texts.

(Sign Language Education Development (SLED), 2006, italics and underlining in original).

The "Languages" learning outcomes (C2005) have been recontextualised to accommodate the different modality (manual) which deaf children need to communicate. For example, "listening" has been recontextualised to "visual listening" as deaf children need to "listen" with their eyes rather than ears; "speaking" has been recontextualised to "signing". The sounds, words and grammar of a language have been recontextualised to include the parameters of sign language, namely, non-manual features, handshapes, palm orientation, movement and location (SLED, 2003).

### 1.3.2.3 The mathematics curriculum

According to SLED (2003), the learning outcomes for mathematics have not been recontextualised specifically for deaf children as they should be exposed to the same curriculum as hearing children are. The Deaf Federation of South Africa (DeafSA, 2006) also advocates that deaf children access the same curriculum as hearing children however appeals to the Department of Education that “educators of Deaf learners receive compulsory in-service training in South African Sign Language” and that “South African Sign Language teaching and learning materials be developed” (DeafSA, 2006: 18). The language used in the classroom will thus affect all learning areas as the appropriate form of sign language is needed to access all aspects of the curriculum.

The egalitarian impulse of the curriculum also fails to take into account the mathematics curriculum as pertaining to deaf children. The assumption is that the national mathematics curriculum is appropriate for deaf children. It does not take the complications of language with respect to mathematics into account. For hearing children, the spoken language used to teach mathematics is quite informal, however the translation into written mathematics is formal. The question to be asked is whether the same applies when sign language is used. The curriculum does not provide teachers of the deaf with expertise to teach the specialised language of mathematics and other subjects in sign language. It also does not provide teachers with the knowledge and resources to translate the sign language into the formalised writing of mathematics. For hearing children, there is a standardised language of mathematics which is used in the teaching of mathematics. For teachers of the deaf, there is no standardised form of the signs to be used when teaching mathematics. They are required to employ their own signs.



#### 1.3.2.4 Sign language as a subject

As stated previously, it was proposed that sign language be taught as a subject or learning area. According to the Deaf Federation of South Africa (DeafSA), a SASL curriculum (for grades R-12) was compiled in 1997 and was approved by the South African Qualifications Authority (SAQA) in 2004 (Deaf Federation of South Africa, 2006). The implementation of the SASL curriculum is problematic in that teachers are not appropriately trained in sign language in their everyday teaching. Teaching sign language as a subject as part of the curriculum requires additional proficiency in terms of knowledge of the syntactic and morphologic structure of the language. Sign language as a school subject gained media attention in a newspaper article. The article indicated that sign language may become a school subject in future as a draft curriculum had been developed (Fredericks, 2010). The article cited a departmental spokesperson as saying that teachers would be trained to teach and understand sign language should the curriculum be implemented. Legislation that deaf children should be taught in sign language was passed in 2001, however the issue of implementing sign language as a subject is still being discussed as a future directive. To date, sign language as a subject is not being taught in schools for the deaf. Deaf children are thus still being denied access to a quality education despite a policy that promotes access and equity.

### 1.3.3 Pedagogy

#### 1.3.3.1 The bilingual-bicultural approach

At classroom level, the bilingual-bicultural approach is promoted as the most effective communication method of teaching deaf children (Aarons & Akach, 1999; Deaf Federation of South Africa, 2006; Department of Education, 1997). The bilingual-bicultural approach advocates the fluent development of a primary or first language such as sign language and the transference of that language knowledge to fluency and literacy in a second language such as English. Deaf and hearing professionals are thus the language models for both these languages (Coryell & Holcomb, 1997) and both languages and cultures are respected in their true form (Deaf Federation of South Africa, 2006). If deaf children had access to education through the medium of SASL, they would then be able to access literacy in a second language. This approach concurs with international trends and has been found to be an effective approach in the acquisition of literacy by deaf children (Aarons & Akach, 1999). Although the bilingual approach has been adopted in certain schools for the deaf in South Africa, it has not been achieved on a practical level (DeafSA, 2006). A possible reason is that due to lack of training, teachers may not fully understand the pedagogy of teaching literacy in a spoken language through a visual-gestural language (Storbeck, 2005). Teachers therefore require training in appropriate pedagogic practices for deaf children.

The feasibility of the bilingual-bicultural approach has been questioned as sign languages do not have a written form. Deaf children are unable to acquire literacy skills in their first language and consequently lack the literacy skills to transfer to the written form of a second, spoken language such as English. Also, the order of sign presentation in sign language does not correspond to the word order in written English, thereby creating encoding challenges for deaf children (Mayer & Wells, 1996). The claims that a sign language, such as American Sign Language (ASL) can be used on its own to bridge the gap between sign and written English, has been challenged (Mayer & Wells, 1996).

#### 1.3.3.2 The implementation of the curriculum in the classrooms of the deaf

The egalitarian impulse of the policy and curriculum downplays deficit and makes certain assumptions at the level of implementation of the curriculum. The assumptions play an important role in how the policy and curriculum is interpreted and how the curriculum is implemented in the classroom.

The curriculum assumes that teachers will have the expertise to accommodate learners in terms of their diversity. The curriculum does not provide teachers with the expertise to deal with the unique needs of learners. The curriculum also does not spell out how the curriculum should be implemented for deaf children and does not make provision for the signs to be used in classroom practice. Furthermore, specialised signs pertaining to subjects such as mathematics are not standardised for teachers of the deaf. Teachers of the deaf are neither required to have sign language training prior to working at a school for the deaf nor are they expected to have any qualifications in terms of pedagogic practices relevant to deaf learners.

The desire at policy level is for all children to have equal access to the curriculum. However at the level of implementation, more resources are required to assist and support the teacher at classroom level. Firstly, more support is needed in terms of teachers' sign language development. More specialised staff is needed to support teachers in terms of implementing the curriculum at classroom level. Specialised staff is needed to fill the gap between the curriculum and the teaching that should be taking place in the classroom.

Added to the lack of support provided to teachers of the deaf, is the policy requirement that teachers working at special schools support neighbouring schools in terms of curriculum and assessment. Teachers at special schools are viewed as the "experts" in the field who need to train mainstream teachers. However, teachers of the deaf themselves are not being adequately trained and supported. Appendix D.2 details the role of special schools in an inclusive model.

Deaf children are thus still at a disadvantage in terms of accessing the curriculum as their access is directly related to the linguistic resources of the teacher. This is not so for hearing children. Deaf children need to learn visually; however teachers are not told exactly how to make the curriculum more visually explicit. There are thus still remnants of the past evident in the education of deaf children, where they are still marginalised despite a policy which recognises the right of all children to have equal access to education. This study aims to gain insight into the teaching practices occurring within the classrooms of deaf children where teachers are faced with the challenges outlined above. The study also aims to determine how these practices affect what mathematics is being taught to deaf children.

## 1.4 The research questions

This study forms part of the general problematic of *what* comes to be constituted as mathematics in pedagogic contexts and *how*.

The particular research questions relevant to the current study are:

*What* comes to be constituted as mathematics in the specific pedagogic context of deaf children at a school for the deaf?

*How* does this constitution come to be realised?

These research questions will be answered based on the study of the pedagogic context of a particular school for the deaf. The empirical site is a school for deaf children who were being taught the National Curriculum Statement through the medium of sign language. The subject of mathematics as it was taught to deaf children in the intermediate phase (grades 4, 5 and 6) through sign language, provided the pedagogic context to be studied. A mathematics lesson was recorded for each grade where a specific topic was taught. The topics were: integers (grade 4), time measurement (grade 5) and fractions (grade 6). The recorded lessons were translated and used for the production of data. From the analysis, important insight was gained in terms of what was constituted as mathematics for deaf learners in the context of a school for the deaf as well as how this constitution came to be realised.

## 1.5 Outline of the dissertation

In Chapter 1, the research questions and rationale for the study have emerged from a detailed description of the policy and curriculum and how these regulations affect the type of pedagogy to be used in classrooms. Chapter 2 will provide a survey of the literature pertinent to mathematics teaching and learning for the deaf. The research literature will be compared to the current study. Chapter 3 presents the general methodological theory relevant to the study. The analytic framework outlining the resources for analysis and description of the data will be explained in Chapter 4. Chapters 5 and 6 describe the data produced during three lessons. Chapter 7 looks at conclusions and directions for future study.

# Chapter 2: A Review of the Literature

This chapter will review the literature on studies pertaining to the education of deaf children in mathematics.

### 2.1. Deaf children's achievement in mathematics

It has long been established that deaf children present with delays in learning mathematics and lag behind their hearing peers in the development of their mathematical skills (Blatto-Vallee et al, 2007; Nunes & Moreno, 2002). Historically, standardised testing in the United Kingdom and the United States showed that deaf children were achieving significantly below their hearing peers and performed at lower levels than hearing children. Studies showed this lag to be between 2.5 -3.5 years (Nunes & Moreno, 2002). In the United States, the norming of the Stanford Achievement Test- 9th Edition for deaf and hard-of-hearing children confirmed that deaf children lag behind their hearing peers despite having normal IQ's (Traxler, 2000). The test was administered to deaf and hard-of hearing children, aged 8- 18 years. For most of the deaf children above nine years, the test was administered at lower grade levels than hearing children of the same age, which is suggestive of an educational delay. The results indicated that in the category "mathematics: problem-solving", the national median for 11-year-olds was at the same level as that of hearing children in their third year of school (8 years). Grade 5 levels were reached when the deaf children were 16 to 18 years. In the category "mathematics: procedures", the national median for 11-year-olds was between grade 3 and 4, only reaching grade 6 at 17 and 18-year levels. Deaf students' scores appeared to asymptote at about 13 or 14 years (Traxler, 2000). Research also showed that deaf students' difficulties with mathematics continued at tertiary level (Blatto-Vallee et al, 2007).

#### 2.1.1. South African statistics

In South Africa, a systemic evaluation conducted in 2003 assessed children with disabilities in the different learning areas. The types of disabilities were blindness, deafness, learning disabilities, partial vision as well as physically disabled children (Department of Education, 2003). According to the report, deaf children achieved a mean percentage of 23.2% for numeracy, which was lower than children with all other disabilities. These results indicated that deaf children in South Africa had difficulties with mathematics, commensurate with international research. Aarons and Akach (1999) reported that the average reading age of deaf school-leavers in South Africa was lower than fifth grade.

## 2.2 Risk Factors and its implications for the delay in learning

### 2.2.1 Hearing loss

Nunes and Moreno (2002) argued that hearing loss was not the cause of poor achievement in mathematics, but was viewed as a risk factor. If all deaf and hard of hearing children were underachieving, then it could be assumed that hearing loss was attributed to the poor achievement. However, research findings showed that 15% of profoundly deaf children performed at average or above average levels on standardised assessments (Wood et al, 1993 in Nunes and Moreno, 2002). There was no empirical evidence to suggest a correlation between hearing loss and mathematics achievement (Nunes & Moreno, 2002). A study by Secada (1984 in Nunes and Moreno, 2002) showed that deaf children's counting followed the same progression as that of hearing children, but at a slower pace. The same applied for their computation skills (Hitch, Arnold and Philips, 1983 in Nunes and Moreno, 2002) and problem-solving ability (Nunes & Moreno, 2002) which was suggestive that deaf and hearing children's mathematical advancement followed the same developmental course (Bull, Marschark & Blatto-Vallee, 2005). If, as the literature suggests, there is no correlation between hearing loss and mathematics achievement, other factors should be considered as possible reasons for deaf learners' underachievement in mathematics. A possible cause could be the nature of mathematics presented to these learners, which is what the current study aims to explore.

### 2.2.2 Reduced learning opportunities

It is commonly accepted that hearing loss provides hearing impaired children with less opportunities for incidental learning (Bull, Blatto-Vallee & Fabich, 2006; Nunes & Moreno, 2002). They lack access to everyday forms of information such as radio and dinnertime conversations. Certain concepts, which are learned incidentally by hearing children, therefore need to be explicitly taught to them (Nunes & Moreno, 2002). One such concept, identified by Nunes and Moreno (2002), is that of *additive composition*. This skill, which is easily learned informally by hearing children through experiences with money, was a difficulty for deaf children. About 60% of 6-year-old and all 7-year-old hearing children were able to carry out this task (Nunes and Bryant, 1996 in Nunes and Moreno, 2002) as compared to 10 and 11-year-old deaf children (Nunes and Moreno, 1998 in Nunes and Moreno, 2002) who were unable to use combinations of coins of different values to add up to a single amount.

### 2.2.3 Inferences in time sequences

Another difficulty faced by deaf children was the ability to communicate about time (Nunes & Moreno, 2002). They experienced more difficulty than hearing children when processing sequences of events occurring over time which required them to fill in the omitted element of the sequence. Consequently, understanding mathematical concepts, such as the inverse relation between addition and subtraction, was a difficulty. A study by Nunes and Moreno (1997 in Nunes and Moreno, 2002) showed that deaf children were on par with hearing children for problem-solving where no inverse operations were required. They were considerably delayed compared to their hearing peers for problem-solving where they were required to make inferences about inversion. They concluded that deaf children required support when communicating and reasoning about time, especially where there were gaps in a story sequence (Nunes & Moreno, 2002).

## 2.3 Factors contributing to the delay in mathematics learning

In the literature, a range of factors have been cited to explain why deaf children lag behind their hearing peers. These factors include access to equal education opportunities, motivation, teaching and learning styles as well as effectiveness of classroom communication (Marschark, Lang and Albertini, 2002 in Bull, Marschark and Blatto-Vallee, 2005). Other reasons cited are linguistic, cognitive and experiential factors (Kelly, Lang & Pagliaro, 2003) as well as difficulties with reading comprehension (Kelly et al, 2003; Mousley & Kelly, 1998). Some of these factors will be described in more detail in the following sections.

### 2.3.1 Processing of information

Although deaf children differ in the way they process information, they are not deficient in doing so (Bull, Marschark & Blatto-Vallee, 2005). Deaf individuals, specifically signers, are advantaged in terms of their visual processing, e.g. speed of shifting visual attention and visual scanning, peripheral detection of motion as well as generation and manipulation of mental images, as well as their spatial processing. However, they have difficulties in the way they organise and use information. They tend to have weaker strengths of associations between concepts and tend towards item-specific processing where they focus on individual item information rather than the relations between items (Bull, Marschark & Blatto-Vallee, 2005). The understanding of mathematical properties is dependent on looking at the components of a mathematical problem and understanding the relations between them. For deaf children and adults, understanding the relations between components has proven to be a difficulty especially tasks where multidimensional relations exist (Blatto-Vallee et al, 2007). It has also been shown that deaf children and adults are more focused on individual words and fragments of text than extracting the meaning of a text in a more holistic form (Marschark, 2003 in Blatto-Vallee et al, 2007) further compounding their difficulties in recognising relationships and connections between mathematical elements. This item-specific processing which occurs whether English or sign language is used (Blatto-Vallee et al, 2007) has consequences for establishing early efficient counting procedures and later a delay in the strong representations of arithmetic number facts in long term memory. Temporal tasks requiring extracting relational information may also prove to be difficult (Bull, Marschark & Blatto-Vallee, 2005).

When solving arithmetic story problems, the critical dimension in problem difficulty for hearing children is the presence or absence of explicit action within the problem situation (Carpenter and Moser, 1984 in Ansell and Pagliaro, 2006). For deaf children, the critical dimension is the operation to be used to solve the problem, rather than the story within the problem. Problems with summed solutions were easier than problems involving the difference between two sets (Ansell & Pagliaro, 2006).

### 2.3.2 Visuo-Spatial ability

The ability to generate visual images plays a role in ones understanding of mathematical concepts (Blatto-Vallee et al, 2007). According to Marscharck in Blatto-Vallee et al (2007) people who use sign language are advantaged in terms of many visuo-spatial domains. Deaf signers should therefore have an advantage over non-signers as their enhanced visuo-spatial abilities should have a positive effect on their mathematical ability. Blatto-Vallee et al (2007) studied the use of visual-spatial representations by deaf and hard-of-hearing students when solving mathematical problems. The study concluded that hearing students used visual-spatial schematic representations to a greater extent than deaf students and performed better in solving the mathematical problems. Schematic representations encode the spatial relations described in the problem. Deaf students tended to use visual-spatial pictorial representations indicating that these students may be focussing on the problem's surface structure and potentially irrelevant information. Pictorial representations encode only the visual appearance of the objects described in a problem. The type of visual-spatial representation used by deaf students thus has a detrimental effect on their problem-solving abilities (Blatto-Vallee et al, 2007).

### 2.3.3 Reading and language comprehension

There exists a strong relation between mathematical and language skills, as language skills allow for access to mathematical information (Bull, Blatto-Vallee & Fabich, 2006). Deaf students tend to have difficulties with word problems due to the linguistic content of the problems. Some English-language structures that have proven to be difficult for deaf children in both written and verbal mathematical instructions include conditionals (*if* and *when*); negatives (*not* and *without*); inferentials (*should*, *could*, *because* and *since*); low-information pronouns (*it*, *something*) as well as lengthy passages (Kelly & Mousley, 2001). They also experience difficulties with comparatives in expressions such as *more than*, *less than*, *faster than*, *three times as many* or *half the number of* (Kelly et al, 2003). The use of the terms *more* and *less* have proven to be a difficulty, especially when learning about fractions (Titus, 1995). Other English-language structures that have proven to be difficult are words that have different meanings within mathematics than outside mathematics, multiple forms of expression for a single concept, varied forms, abbreviations and symbols (Kidd and Lamb, 1993 in Kelly, Lang and Pagliaro, 2003).

Reading comprehension levels of deaf children aged 8-12 years has also been directly related to their problem-solving skills, as deaf children were better able to solve problems where the data, the unknown factor and the conditions were presented in a similar manner in which the operation needed to be carried out (Pau, 1995 in Mousley and Kelly, 1998). Kelly, Lang, Mousley and Davis (2003) concurred that deaf college student's comprehension and subsequent problem-solving ability improved with relational statements which were consistent with the required arithmetic operation, e.g. using addition with terms like *more than*. The reading ability levels of deaf college students directly influenced their problem-solving performance on word problems (Kelly & Mousley, 2001). An increase in reading grade level resulted in fewer multiple errors as well as problems left blank. However, reading level did not affect the frequency of reversal errors when solving word problems with relational statements which were inconsistent with the arithmetic function required, e.g. using addition when the relational term was *less than* (Kelly et al, 2003).

### 2.3.4 Problem-solving ability

A study by Kelly and Mousley (2001) comparing the problem-solving abilities of deaf and hearing college students found that deaf students made more computation errors rather than procedural errors and left more problems blank. They also demonstrate difficulties remembering what content has been learned as well as the transferring learning into different contexts. There are thus other factors that affect their word problem-solving rather than just reading comprehension (Kelly, Lang & Pagliaro, 2003).

### 2.3.5 Conceptual development

Other studies which focused on specific concepts showed that deaf children have significant delays in their mathematical conceptual development such as measurement, number concepts, counting and fractions (Zarfaty, Nunes & Bryant, 2004). Studies showed that deaf children were significantly worse than their hearing counterparts in terms of counting. A study by Nunes and Moreno (1998 in Zarfaty et al, 2004) showed that most deaf children, in either oral or signing programmes, who were in their second or third years in primary school, were unable to count to 60. Most hearing children are able to do so in the first year of school. The implication is that deaf children are at risk for developing addition and subtraction skills in the early school years (Zarfaty, Nunes & Bryant, 2004). Deaf college students were not significantly different from a hearing group in terms of subitising, therefore basic differences in subitising skills do not account for the mathematical difficulties of deaf adults. Deaf college students were less efficient at retrieving magnitude information similarly found in hearing children with weak arithmetic skills (Bull, Blatto-Vallee & Fabich, 2006).



Deaf and hard of hearing students between the ages of 10 and 16 years were found to lag behind their hearing peers in their development of the concept of fraction size. Their performance on fractional ordering tasks did not improve with age as was observed with hearing students. The deaf students were comparable to hearing children who were learning initial fraction concepts as the deaf students were negatively influenced by the size of the counting numbers which the fractions were composed of. The study concluded that deaf and hard of hearing children develop concepts of rational numbers similarly to hearing children; however, the development is delayed (Titus, 1995).

### 2.4 Possible origin for difficulties in mathematics

So where do the difficulties experienced by deaf children originate? Most of the studies reviewed here, focused on describing the types of difficulties they experience. Few studies provide reasons for their difficulties (Zarfaty, Nunes & Bryant, 2004) and there is limited research regarding the nature of teaching presented to them. A possibility is the interaction between the innately determined core representation of number and cultural factors such as schooling and language acquisition (Bull, Marschark & Blatto-Vallee, 2005). In order to gain a better understanding of the reasons why deaf children experience difficulties, it is necessary to pinpoint when the delay first occurs. Does this lag originate in the pre-school years or does it occur during the formal school years? There is evidence to suggest that their lack of progress can be attributed to the quality of mathematical teaching that they receive (Zarfaty, Nunes & Bryant, 2004), however there is a lack of research conducted on the nature of teaching presented to these children. The current study aims to address this gap in the research by exploring the operational activity of teachers and learners. In so doing, it can be argued that the type of mathematics produced by learners can be attributed, to a large extent, to what is distributed by the teacher.

#### 2.4.1 Pre-school

Empirical evidence has shown that hearing children are able to informally learn about number before going to school which facilitates their understanding of mathematical concepts when they receive formal instruction (Zarfaty, Nunes & Bryant, 2004). While there have been many studies regarding deaf children's achievement during the school years, which have shown that they experience difficulties in mathematics; there is little evidence about their understanding of mathematics at the pre-school level. Zarfaty et al (2004) were interested in investigating whether deaf children were disadvantaged during the pre-school years where learning is informal, or when they started their formal learning at school. The researchers concluded that deaf children do not experience problems with number representation in the pre-school years. The implication is that deaf children do not start school with inadequate number representation; however they experience difficulties at school either due to minimal opportunities to learn or because they are less able to learn the culturally transmitted aspects of mathematical knowledge, such as a counting string and written numbers. The results of this study, which was conducted on only 10 deaf children who were in an oral programme, cannot be generalised to signing children (Zarfaty, Nunes & Bryant, 2004). A study by

Masataka (2005) concurred with Zarfaty et al (2004) that deaf children do not begin school with inadequate number representation, but that they have fewer opportunities to learn or are less able to learn the culturally transmitted aspects of mathematical knowledge (Masataka, 2006). The literature focuses on the difficulties learners experience with mathematics but do not describe the pedagogic practices of teachers. The current study aims to address this shortfall in the literature by observing and examining the classroom practices of teachers during mathematics lessons.

### 2.4.2 Teaching practices

A study by Kelly, Lang and Pagliaro (2003) showed that teachers of the deaf spent more time on application of procedures to practice exercises, rather than on problem-solving situations. Teachers also focussed more on visualisation strategies, surface cues, language comprehension and exercise drills than on analytical strategies and cognitively challenging problems. The perceptions teachers had of deaf students' capabilities to solve word problems may have resulted in the inadequate problem-solving experiences given to deaf children. Their study also found that teachers were more concerned with the comprehension of word problems rather than problem-solving strategies. Teachers' focus on comprehension may stem from their perceptions of deaf children as having generally lower English language and reading abilities. Consequently, teachers may also avoid more cognitively challenging aspects of word problem solving. Teachers also reported that they often only taught simple, straightforward, familiar problems and avoided complex, unfamiliar problems. The implications were that deaf children were under-prepared for post-secondary education as well as their problem-solving ability when employed or in real-world situations (Kelly, Lang & Pagliaro, 2003).

Teachers were less likely to use story problems in grades K (Kindergarten) and 1 than grades 2 and 3 indicating that teachers may be waiting until children acquire proficiency with operations and number facts. Also, teachers used more written language with a signed version of the story as students progressed through the grades. Teachers with more experience included story problems more frequently than those with less experience (Pagliaro & Ansell, 2002).

The studies described employed surveys or reports from teachers as their methodology for obtaining data about teaching and learning in deaf education. In contrast, the current study used classroom observation to obtain data regarding the nature of pedagogic practice in the classroom, as there are limited studies on the pedagogic practices of teachers of the deaf.

### 2.5 Teacher training

Lack of teacher training in mathematics may result in poor teaching practices. A study showed that teachers of the deaf and hard of hearing were inadequately trained in mathematics as more emphasis was placed on developing teachers' communication skills (Titus, 1995). Kelly, Lang and Pagliaro (2003) found that teachers without mathematics certification were not as aware of problem-solving strategies and were not professionally prepared to teach them. Pagliaro and Ansell (2002) proposed that teachers of the deaf enter the profession having knowledge of mathematics content, how students acquire the content as well as the appropriate pedagogic practices needed to foster learning. In South Africa, it is not a requirement that teachers of the deaf have training in sign language or mathematics pedagogic practices specific to deaf children's learning, prior to working at a school for deaf children. They are expected to learn these skills through in-service training. Research is needed to determine whether in-service training adequately equips teachers with the necessary specialised skills needed to teach these learners.

### 2.6 Intervention strategies/ pedagogic methods

According to Nunes and Moreno (2002), if hearing loss is a risk factor for development in mathematics, then negative effects can be prevented by appropriate intervention.

#### 2.6.1 An intervention programme

Nunes and Moreno (2002) devised an intervention programme to develop the mathematics skills of deaf children. The aims of the programme were twofold: to provide opportunities for deaf children to learn core mathematical concepts which hearing children learned informally outside the school environment. The connections between these concepts and mathematical representations used in the classroom could then be supported. The second aim was to improve their access to word problems where events changed over time by using diagrams and drawings. These visual representations of the problem would reduce the need to retain sequences of events in memory. Their study concluded that the programme was effective in improving deaf children's access to the mathematics curriculum and also promoted deaf children's achievement in numeracy.

The programme covered four concepts which deaf children have difficulty with. These concepts were *additive composition*, *additive reasoning*, *multiplicative reasoning* as well as *ratio and fractions.* The programme was presented to the children in the form of a booklet containing pictures with no text. Teachers provided the instructions in the children's language of instruction. The programme proved to be an effective tool in increasing the deaf child's access to the mathematics curriculum. The relevant features of the programme will be described in more detail.

**a) Additive Composition**

An aim of this segment was to strengthen informal knowledge of money and additive composition. The programme indicated that deaf children benefited from representing the non-unitary coins with their fingers prior to counting the total sum of money. It was also helpful to use number words to represent the values.

Another aim was to improve their understanding of measurement in order to expand the use of additive composition. Deaf children's understanding of measurement was often incomplete as they were not clear about the point from which to start measuring, i.e. zero or one when using a ruler. Rulers were an important resource in supporting students' understanding of mathematical conventions when used as a number line.

The third aim of this segment was to introduce the number line as an instrument to represent and solve problems. Number lines are a form of conventional mathematical representation and are also a visual representation of number sequences. Because deaf learners were more efficient at processing visual information, the number line was a useful tool in problem-solving.

**b) Additive Reasoning**

The aims of this segment in the programme were to support the understanding of addition and subtraction as being inversely related, using drawing and diagrams to represent time through spatial relations and also to demonstrate that the number line can be used for calculation and can also be used as a tool to generate multiple answers to the same problem. It was found that concrete objects proved useful as a bridging tool to the booklet, especially for younger children. The use of drawings to represent time-related sequences proved to be a useful tool when solving problems.

**c) Ratio and Fractions**

The aims of this section were to enable the students to work with sharing and division as a starting point for reasoning about fractions; to establish connections between fractions and division and fractions and ratio. These aims were achieved using diagrams. Teachers found this section difficult to work with as they were not used to connecting ratios and fractions. Although the children also had difficulty with this section, they were able to access the easier problems.

### 2.6.2 Visually explicit modes of representation

As shown by Nunes and Moreno's intervention programme, deaf children benefit from more visually explicit material (Chen, 2006) with a variety of representation strategies such as written and graphic representation (Kelly et al, 2003). The use of tables and graphs are important in showing relations between variables (Nunes & Moreno, 2002). According to Titus (1998) deaf children benefit from different modes of representation when learning about rational numbers such as physical, verbal, pictorial as well as symbolic representations as these representations facilitated their conceptual development. Because deaf children were said to be more visual and concrete learners, the Japanese art of paper-folding or origami was a useful tool for teaching mathematical concepts such as spatial visualisation, intersecting planes, area, volume, mirror images and symmetry (Chen, 2006).

### 2.6.3 Spatial representations of number

A study investigating the performance of young deaf children in spatial and temporal number tasks (Zarfaty, Nunes & Bryant, 2004), showed that deaf children may learn mathematics more easily and successfully if the teacher used spatial rather than temporal representations.

### 2.6.4 Signs used by teachers

The type of signs used by teachers assisted deaf children when learning mathematics. Lang and Pagliaro (2007) found that deaf high school students were significantly better able to recall mathematical terms represented by a single sign than those terms requiring compound signs and fingerspelling. Their study also concluded that high signability terms were more easily recalled than low signability terms; high imagery terms were better than low imagery terms; high familiarity terms were preferred over low familiarity terms and concrete terms were better recalled than abstract terms. The implications for teaching are that teachers with strong content knowledge are better able to facilitate the acquisition of mental imagery. It is therefore of utmost importance that teachers are formally trained in strategies to improve the visualisation skills of deaf students. Teaching of new vocabulary should use pedagogies that build on prior knowledge and contexts which relate the new concept/ word to a pictorial representation. In order to support compound signs and fingerspelling used in mathematics, visual materials may be needed as reinforcement of these terms (Lang & Pagliaro, 2007).

As shown by the literature survey, deaf learners experience many difficulties when learning mathematics. The bulk of the literature focuses on learners' difficulties with learning mathematics. Limited attention is paid to the pedagogic practices of teachers, which is what I'm interested in exploring. The literature reviewed does not focus on what comes to be constituted as mathematics in classrooms, which is the focus of my study. Having identified the purpose of the study, the pertinent theoretical framework drawn on will be presented in Chapter 3. As stated in Chapter One, the topics of the observed lessons were *integers*, *fractions* and *time*. For a review of the literature regarding these topics; see Appendix F.

# Chapter 3: The Theoretical Framework

In order to generate the data required for analysis, appropriate theoretical referents need to be drawn on for the production of an analytical language. The theoretical referents will provide a framework for the construction of the researchable context and the research objects to be studied. This chapter presents the theoretical framework which produces the conceptual and theoretical resources for the construction of the analytical framework. The conceptual resources drawn from are that of Bernstein's theory of the pedagogic device (Bernstein, 1996) which has been used to situate the current study. Further methodological resources have been selected from work by Davis (2001, 2009, 2010a, 2010b, 2010c, 2011a, 2011b, 2011c) regarding the implications of evaluation and the constitution of mathematics. In addition, the use of morphisms as a resource will be described. The methodological resources and the application thereof will produce the data needed to answer the research questions of *what* gets constituted as mathematics and *how* in four lessons presented to deaf learners.

## 3.1 Introduction

The research questions are concerned with the pedagogy which unfolds in the pedagogic situation, specifically the nature of the mathematics presented to a group of deaf learners. The aim of the study is to determine what is constituted as mathematics for these learners. As an initial, more general approach to the theory, it can be stated that it is at the pedagogic site that knowledge is transformed into pedagogic communication. The transformation of knowledge into pedagogic communication forms part of a larger structure, which is dependent on three crucial aspects. The first aspect is concerned with the important question of "who gets what?" Here, the "what" refers to the knowledge that is chosen to be made available, the "who" being those to whom the selected knowledge is made available. The second aspect is concerned with the manner in which the selected knowledge has been organised for its transmission. In other words, how the knowledge is to be realised. The knowledge and learning that occurs in the classroom is the final aspect and is the point at which the knowledge is transmitted by the teacher and acquired by the learners. Of concern here is what *is* realised as knowledge, and in particular, mathematical knowledge.

The transformation of knowledge into pedagogic communication is described in more technical terms by Bernstein (1996) who theorised the pedagogic device as a model for describing the transformation of knowledge. The pedagogic device as a theoretical resource will be explicated and discussed in section 3.2. For a more detailed explanation, see Bernstein (1996) and Singh (2002). The pedagogic device provides a framework within which the current study can be positioned.

### 3.2 The pedagogic device

According to Bernstein (1996) all instances of transmission and acquisition of culture can be described in terms of the pedagogic device. Bernstein's theory of the pedagogic device (Bernstein, 1990; 1996; 2000) can thus be legitimately applied to describe pedagogic practices within classrooms where the transmission and acquisition of culture occurs. The pedagogic device describes the structure implicated in the transformation of knowledge into pedagogic communication. In other words, the pedagogic device provides a model for analysing the processes whereby discipline or domain-specific expert knowledge is converted or recontextualised to constitute school knowledge and provides researchers with explicit rules to describe the macro and micro structuring of knowledge (Bernstein, 1996; Singh, 2002).

The "intrinsic grammar" of the pedagogic device is provided by three interrelated rules: the distributive rules, recontextualising rules and evaluative rules. The three rules are hierarchical in nature in that the recontextualising rules are derived from the distributive rules and the evaluative rules are derived from the recontextualising rules. The rules regulate the pedagogic communication which is made possible by the device. The distributive, recontextualising and evaluative rules will be described in more detail in relation to the current study.

#### 3.2.1 The distributive rules

According to Bernstein, the distributive rules are concerned with the distribution of forms of consciousness through the distribution of different forms of knowledge. The distributive rules operate within the field of the production of knowledge or discourse and occurs through the process of knowledge production. The main purpose of distributive rules is to regulate what people should know. In other words, the distributive rules are concerned with who gets what knowledge. At a macro level, the content of the distributive rules of the pedagogic device can be described in terms of the political. As described in Chapter 1, the change in political power in 1994 resulted in transformation at a constitutional level where the values of equity and access were promoted. The values engendered constitutionally filtered down to educational policy for children with special needs, which included children who are deaf. Change at the level of political power resulted in profound transformation at three instances or levels of the education system: education policy; curriculum planning, design and delivery as well as at the level of pedagogic practices within the classroom. The current education policy for children with special needs is thus based on an egalitarian impulse where previously applied boundaries between children of different race groups and disabilities were eradicated. In addition, the language of deaf people—sign language—although not an official language has received recognition as a language and currently receives official status as a medium of instruction in schools. At the level of policy, the State is able to legislate on the distribution of forms of knowledge and, in so doing, is partially able to regulate who gets what knowledge and why.

### 3.2.2 The recontextualising rules

Recontextualising rules regulate the formation of specific pedagogic discourses (Bernstein, 1996) which is how knowledge is organised for its distribution. Pedagogic discourse is defined as a principle which embeds two discourses: an instructional discourse and a regulative discourse. The instructional discourse is the discourse which creates specialised skills while the regulative discourse is a moral discourse which creates order, relations and identity. The instructional discourse is embedded in the regulative discourse and the regulative discourse is the dominant discourse (Bernstein, 1990, 1996, 2000). In other words, pedagogic discourse creates a moral ordering of the social relations of transmission and acquisition referring to the rules of appropriate conduct, character and manner in classroom contexts. The moral order of the classroom is a necessary pre-requisite for the transmission of instructional discourses (Singh, 2002).

Bernstein (1996) describes pedagogic discourse as a recontextualising principle. The recontextualising principle selectively appropriates, relocates, refocuses and relates other discourses to constitute its own order. The term pedagogic discourse describes the rules or principles for generating and producing different pedagogic texts or practices (Singh, 2002) for the transformation of knowledge into pedagogic communication. The recontextualising rules operate within the field of recontextualisation of knowledge. The recontextualising principle not only recontextualises the *what* of pedagogic discourse—the subject and content of what becomes pedagogic practice—it also recontextualises the *how*, which is the theory of instruction. Both the *what* and the *how* are elements of the regulative discourse (Bernstein, 1996).

For teachers and deaf learners, the knowledge as distributed by those in authority needs to be recontextualised into pedagogic communication in order to be transmitted within classrooms. The curriculum, which needs to be made accessible to deaf children through the medium of sign language, needs to be recontextualised for the transmission and acquisition in classroom contexts.

The recontextualising principle creates recontextualising fields as well as agents with recontextualising functions. Specialist expert knowledge generated within agencies of higher learning is encoded in highly complex symbolic forms and needs to be translated or pedagogised in order to be accessible to those outside of specialist domains. The pedagogising of knowledge occurs within agencies of recontextualisation (Singh, 2002). According to Bernstein (1996) the recontextualising field consists of an Official Recontextualising Field (ORF) and a pedagogic recontextualising field (PRF). The ORF is created and dominated by the State and its selected agencies; while the PRF consists of teachers in schools and colleges, departments of education, specialised journals and private research foundations.



For the education of deaf learners, the ORF does not provide specific guidelines for the transmission of the recontextualised discourse. Recontextualisation of teaching and learning resources for mathematics is necessary to accommodate the teaching and learning needs of teachers and deaf learners. The mathematics curriculum has not been recontextualised to become accessible to deaf children. The education department has not provided the necessary training in sign language. Specialised signs for mathematics terminology have not been made available to teachers. It was my experience that teachers were expected to figure out the signs or to create their own signs to teach specific topics such as integers or fractions. Agencies within the PRF, such as non-government organisations have recontextualised parts of the curriculum statements in order to render it more accessible. An example is provided in Chapter 1 (section 1.3.2.2) where the learning outcomes for the *Languages* curriculum have been recontextualised to be more relevant and accessible to deaf children. However, curriculum resources such as text books also require recontextualisation. In deaf education there is considerable emphasis at the level of policy in terms of equity and accessibility—at the level of knowledge distribution. However, in terms of the recontextualising rules there are severe limits or restrictions for deaf learners in accessing the curriculum.

While the distributive rules are concerned with power and the recontextualising rules with control, Bernstein described a third category—the evaluative rule—which focused on the criteria for the production of legitimate utterances in the pedagogic context.

### 3.2.3 The evaluative rules

The processes of transmission and acquisition within the context of pedagogic practice operate at the level of the evaluative rules of the pedagogic device. The actual distributive effects of the device occur at this level. According to Bernstein (1996: 50) "…the key to pedagogic practice is continuous evaluation" where *evaluation* refers to student-teacher interactions, questions, problems, tests, projects and examinations (Davis, 2001). Pedagogic practice is inundated with evaluative acts that are continually performed by teachers and their students. The evaluative rules translate pedagogic discourse into pedagogic practice through time, text and space and are ultimately where the acquisition, evaluation and transmission of knowledge occur (Bernstein, 1996). The pedagogic device provides a framework in which the current study can be situated, that of the evaluative level as this is the point of transmission and acquisition of knowledge.

For Bernstein, the whole of the pedagogic device is condensed in the evaluative rules as the evaluative rules are derived from the recontextualising rules which in turn are derived from the distributive rules. The contents of the distributive and recontextualising rules thus reside within the evaluative rule as the entire structure of the device is captured and structured at this point. Evaluative activity attempts to realise the imperatives from policy and curriculum and according to Davis is the "mechanism mediating the field of knowledge-learner encounter" (Davis, 2010c). Pedagogic evaluation distinguishes legitimate learner responses for the production of knowledge, what Davis describes as "what *ought* to be in play in teacher and learner activity" (Davis, 2010c, italics in original). Pedagogic evaluation is thus concerned with the content that "*ought*" to be realised in the pedagogic situation. It is possible that the evaluative activity produces different realisations from the intended "what" for which control mechanisms such as external examinations, curriculum advisors and systemic evaluations are in place.

Based on Bernstein's proposition that pedagogy is essentially evaluative, Davis (2010a, 2010b, 2010c, 2011a, 2011b, 2011c) has produced methodological resources for the purpose of describing pedagogic practices occurring within classrooms. The methodological resources fashioned employ the essential properties of mathematics for the description of recognition and realisation rules in terms of objects and operations. The following section explicates particular resources produced for descriptions on the constitution of mathematics in various contexts which are relevant to the current study.

### 3.3 The constitution of mathematics

According to Davis (2010b), the study of the operational features of scriptural practices of teachers and learners allows one to draw conclusions regarding the pedagogic practice within that context. In order to describe the operational features, an examination of what it is that teachers and learners do is required. Within pedagogic contexts, criteria are generated for the recognition and realisation of mathematical objects or operations and processes. For Davis and Johnson "mathematics is *constituted* through the operation of evaluative criteria" (2007: 130, italics in original) which determine what is realised as mathematics. In others words, it is through the production of criteria that the objects and operations are made available. Learners are not only expected to recognise the objects with which they are engaged, but are also expected to reproduce the responses required by the teacher or the legitimate text. When describing the features of scriptural practices, it is essential to examine the operations or operation-like manipulations occurring within the pedagogic context. By describing these operations, one can invariably form descriptions about the objects that are being employed. In so doing, the mathematical activity occurring within the pedagogic context can be expounded and the operational logic employed therein can be illustrated. Analysing and describing the objects and the operations performed on them allows for the production of data for the description of pedagogic practice. Figure 3.1, taken from Davis (2010b), shows the relationship between scriptural practices and operational activities which produce the domains and logic of operation which then restructure the scriptural practices.

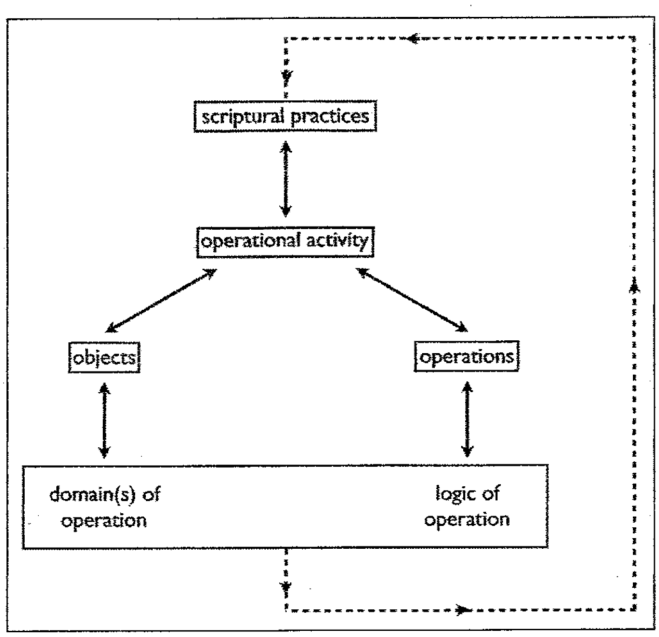


**Figure 3.1 Successive redescriptions of scriptural practices** (Davis, 2010a)

### 3.3.1 Objects and operations

Davis (2011c) asserts that operations are functions working in a predictable manner in that functions give rise to specific outputs from given inputs. A function is a mapping from elements of one collection or set of distinct entities, called the domain, to elements from another set of distinct entities, called the co-domain. The distinguishing feature of a function is that a unique output is produced for any given input. The set of entities making up the domain and co-domain can be comprised of any objects such as physical objects, numbers or even concepts such as freedom or love (Gallistel & King, 2010a). The elements in the domain are the inputs or arguments and the objects in the co-domain are the outputs or values. It is essential to mathematics that operations are functions, so if one is claiming to be doing mathematics, then the operations employed must be functions. If the operations are not functions, they become unstable and unfeasible. This essential property of operations being functions renders the operations as context-independent, as it cannot change in various situations such as the field of production, the classroom or the curriculum (Davis, 2010c).

Descriptions of the operational activity of teachers and learners in terms of operations and their objects, allows for a comparison with operational resources in the mathematical body of knowledge. This body of knowledge, referred to as the *mathematics encyclopaedia* by Davis (2011a) refers to the network of “formal rules, concepts and systems” described by Mac Lane

(1986: 409), which underpin the development of mathematics. Mathematical knowledge is generated within the field of production of mathematics. Selections of this content is recontextualised for the purposes of teaching; such as in curricula, text books and pedagogy in order for its reproduction by learners in the classroom. This study will compare the objects and operations employed by teachers in reference to objects and operations recognised in the field of production, referred to as the mathematics encyclopaedia.

In school contexts, the basic arithmetic operations of addition, subtraction, multiplication and division are binary (Davis, 2010c). A binary operation is defined as an operation which is performed on two numbers to produce another number (Open University: Mathematics Foundation Course Team, 1970: 7). It is the case in the pedagogic contexts of schooling that operations are replaced with rules consisting of more than one operation which produce the same solution to the original operation. In other words, different rules can be applied to elements in a domain to produce the same element in the co-domain. Consider the example of $f(x) = (x + 1)^2$ which is equivalent in terms of value to $g(x) = x^2 + 2x + 1$. For $f$, the rules "add 1 to the input value and then square" are different to $g$, "square the input value, double the input value, add the two results and then add 1" however the same output is produced (Lawvere and Schanuel, 1997 in Davis 2011a: 99-100). In pedagogic practice, teachers may use manipulations in replacement rules which are not familiar mathematical operations. However, these operation-like manipulations may produce a unique output which renders them functions. Davis (2011a) points out that there are instances where the objects and operations or operation-like manipulations are not recognisable as being mathematical.

To illustrate the use of an operation-like manipulation, I draw on the example described by Davis (2010a, 2010b) which discusses a teacher's procedure for integer addition using the sum of -7 and 2, shown in Figure 3.2. The teacher's procedure is summarised in the following steps:

1. The numbers are detached from their signs (+ and -), transforming the integers into "whole numbers".
2. The smaller and larger between the two "whole numbers" is distinguished.
3. The symbol of the larger "whole number" is determined.
4. The smaller "whole number" is subtracted from the larger one.

5. The symbol of the larger "whole number" is coupled to the difference calculated between the two whole numbers (Davis, 2010).

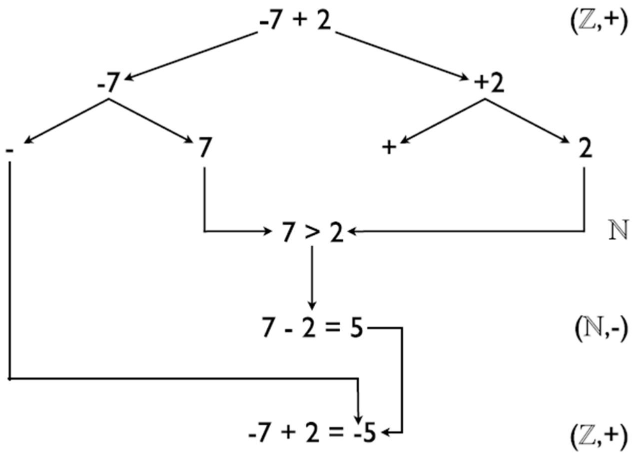


**Figure 3.2 A description of teachers' procedure for adding integers** (Davis, 2010a)

The criteria generated give the idea of "whole number" calculation rather than operations performed on integers. The first step in the procedure entails splitting the signs from the numerals. Such an operation does not exist in the field of mathematics. Splitting signs from numbers termed *sundering* by Davis (2009 as cited in Jaffer, 2009) is a manipulation that does not produce a unique output for a given input. Sundering is explained as an operation-like manipulation whereby a mathematical expression is broken up into two or more expressions. For example, the expression /−7 + 2/ could be separated into /−/ and /7 + 2/; /−/, /7/ and /+2/ or even /−/, /7/, /+/ and /2/ (Jaffer, 2009). The operation-like manipulation occurring in step 5 has been termed *concatenation* (Davis, 2009) and combines two or more expressions into a compound expression. For example, the negative sign /-/ and number /7/ can be combined to produce /-7/ (Jaffer, 2009). Concatenation is more like a mathematical operation because it produces a unique output from a given input. The topic is announced as integers, however the procedure employs the use of operation-like manipulations that permit the shift from the domain of integers to "whole numbers" then back to integers. Other examples are given of learners who are described as shifting between different domains which implies shifts between different types of objects and operations during computations (Davis, 2010c). In this example, the objects which are treated as characters, and the operation-like manipulations employed over them are not recognised in the field of production in mathematics.

### 3.3.4 Morphisms

In pedagogic situations, teachers may resort to using analogies or metaphors which they believe may assist learners to engage with and understand a new topic. For example, a teacher may use slices of "cake" as a representing system to represent the mathematical concept of proportion when teaching about fractions. Teachers may also provide alternate means to produce a solution to a mathematical problem using replacement rules as described in section 3.3.1. They may substitute mathematical content with other content or they may use other mathematics to produce a solution. For example, a teacher may exposit on the factorisation of prime numbers, using natural numbers instead of prime numbers (See Davis, 2011a). In order to describe these pedagogic practices in a robust and stable manner, the structure of morphisms were used. This section will explain the notion morphisms first in general mathematical terms, then with application to a specific example.

According to The Open University (1970: 25) a morphism is defined as a function $f$ from the set A with a binary operation $\circ$, which can be represented as $(A, \circ)$, to the set $f(A)$ with the binary operation $\square$, written as $(f(A), \square)$. A binary operation is defined as an operation which is performed on two numbers to produce another number (Open University: Mathematics Foundation Course Team, 1970). The function is written as:

$$f:(A, \circ) \longrightarrow (f(A), \square)$$

In many instances $f$ (A) is a subset of A and the operation $\square$ is the same as the operation $\circ$. However, in many mathematical examples, it is possible to have a modelling of one set with a binary operation by another set with a different binary operation. A morphism occurs where the function links both the sets as well as the binary operation performed on each set (Baker, Bruckheimer & Flegg, 1971).

A morphism is dependent on a mapping in which the structure is preserved (Baker, Bruckheimer & Flegg, 1971). This structure-preserving feature can be explained using the example of the set A with the binary operation of $\circ$ which is written as $(A, \circ)$. It is possible that this calculation may be too complex which leads to a mapping of $(A, \circ)$ to another set $(B, \square)$ which is more familiar and easier to calculate. The mapping that occurs needs to be done in a manner such that the answers calculated in $(A, \circ)$ and $(B, \square)$ should correspond. The mapping is written as: $f(a_1 \circ a_2) = f(a_1) \square f(a_2)$. If the operations are performed correctly and the outputs correspond, then the mapping has preserved the structure and is considered a morphism. A morphism is a function between two algebraic objects where the algebraic structure is preserved. The mapping can be represented diagrammatically as follows:

$$\begin{tikzcd}
A & (a_1, a_2) \arrow[r, "\circ"] \arrow[d, "f"'] & (a_1 \circ a_2) \arrow[d, "f"] \\
B & (f\ (a_1), f\ (a_2)) \arrow[r, "\square"] & f(a_1 \circ a_2) = f\ (a_1) \square f\ (a_2)
\end{tikzcd}$$

**Figure 3.3 A mapping between two sets (Bruckheimer & Sterling, 1968: 1728)**

Figure 3.3 indicates that the solution can be obtained by either first doing the mapping of the function on A then doing the calculation (down then across) or first doing the calculation in A then doing the function (across then down). This diagram is described as commutative because the function *f* is a morphism (Baker, Bruckheimer & Flegg, 1971).

In pedagogic contexts, a morphism can be thought of as a representation of the mappings or functions that connect two systems. The two systems are a representing system and a represented system. Based on the conditions described above, a morphism can be defined as a representation of the structure-preserving, “behaviourally efficacious mappings” from the represented system to the representing system (Gallistel & King, 2010b: 55). The concept of a morphism “permeates and shapes mathematics from the kindergarten through the graduate school” (Krause, 1969).

The notion of a morphism is closely linked to the idea of a *mathematical model* (Open University: Mathematics Foundation Course Team, 1970) which is an example of a morphism. For instance, mathematical models can be constructed from things or processes in the physical world where a connection is formed between the physical world (representing system) and the mathematical world (represented system). Mathematically, the connection between the two systems can be described as a function (Krause, 1969). Due to the modelling property of morphisms, physical situations consisting of a possible mechanical or electrical operation can be paralleled to mathematical sets and mathematical operations (Open University: Mathematics Foundation Course Team, 1970). Morphisms can be internal to mathematics. Here, morphisms are used to describe mathematical models of physical situations. A mathematical model can be defined as mathematical structure where certain features of the physical world are represented. Figure 3.4, taken from Open University (1970: 25), shows the relationship between the represented and representing systems when using mathematical models to describe physical situations.

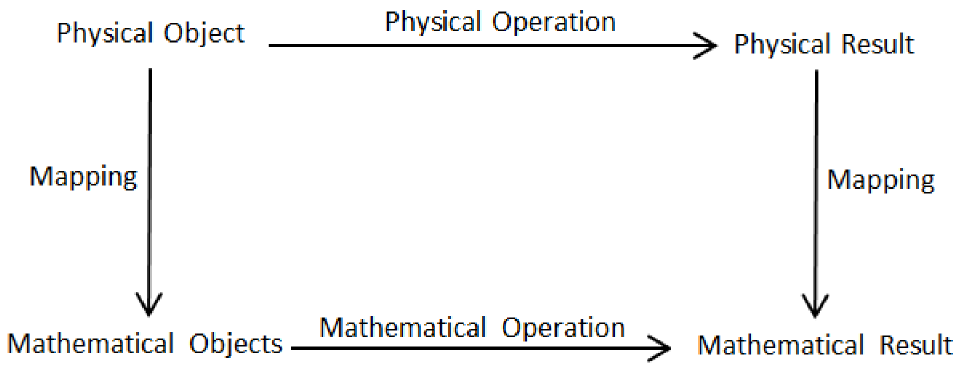


**Figure 3.4 The relationships between the represented and representing systems**

A physical operation performed on a physical object produces a physical result. The physical object can be mapped to a mathematical object on which a mathematical operation is performed to produce a mathematical result. The physical result is then mapped to the mathematical result. An important aspect of the model is whether the route from the mathematical result to the physical result can be taken, which determines whether the mathematical result can be translated back into the physical context. It is entirely possible that the mathematical model may represent only certain aspects of the physical situation and will result in a close approximation to the physical result (Bruckheimer & Sterling, 1968; Open University: Mathematics Foundation Course Team, 1970). Mathematical models are useful for setting up a problem in a certain way then confronting the problem in a completely different way while preserving the structure of the mathematical objects and operations.

In pedagogic contexts, morphisms could occur where teachers use analogies to compare mathematical objects to other objects. For example, a teacher may use the counting of collections of sweets as the representing system to explain whole number addition, which is the represented system. See Figure 3.5.


**Figure 3.5 Adding two sets of sweets (Davis, 2012)**

For the representing system, the cardinality of the two collections of sweets are determined, then merged to form a third collection. The operation of merging the collections is represented by disjoint union $(\cup^*)$ which is meant to be a basis for the mathematical operation of addition. The operation of addition on natural numbers is the represented system which is mapped to the representing system through the function of counting. The mapping is shown in Figure 3.6:

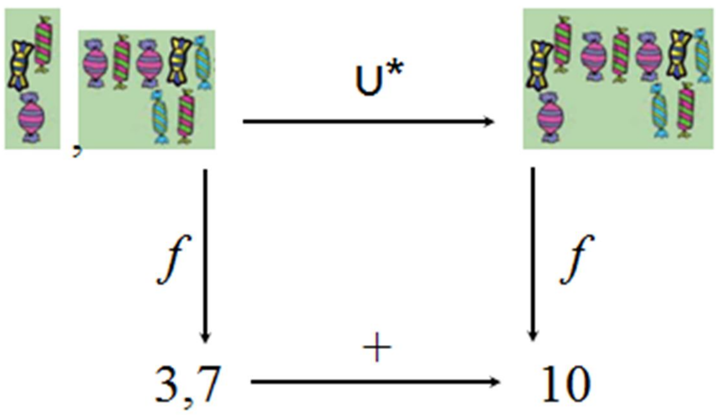


**Figure 3.6 The mapping between addition and disjoint union**

Figure 3.7 shows the relationship between the addition of natural numbers to disjoint union. Let *f* be the counting function, let ∪ *be the binary operation of disjoint union over sets, and let + be addition over ℕ. Given the class of finite sets, S, there exists morphism-like structure, f: (S, ∪) → (ℕ, +), that maps disjoint union to addition.

$$\begin{tikzcd}
A,B \arrow[r, "\cup^*"] \arrow[d, "f"'] & A \cup B \arrow[d, "f"] \\
f(A),f(B) \arrow[r, "+"] & f(A \cup B) = f(A) + f(B)
\end{tikzcd}$$

**Figure 3.7 A mapping of addition to disjoint union**

In pedagogic contexts, teachers may use morphisms to recontextualise knowledge for learners through the use of models or analogies. As an analytic resource, organising data in terms of a morphism provides important additional information regarding what gets constituted as mathematics and how. By examining the objects and operations as well as determining their relationship produces further data which relates back to the recontextualising principle. By applying the structure of morphisms, important data regarding the manner in which mathematics is modelled can be produced. In other words, the structure of a morphism provides added data about how knowledge is organised for this group of learners. The recontextualising principle in turn relates back to the distributive principle which describes who gets what. For the purposes of this study, I am concerned with what is constituted as mathematics for this group of learners. The distributive principle translates into what knowledge this specific group of learners are getting.

In summary, descriptions of what comes to be constituted as mathematics in pedagogic contexts are made available through the operational activity of teachers and learners. The operational activity reveals three important aspects:

1. The operations that are employed in the pedagogic situation.
2. The collections of objects over which the operations are performed.

3. The criteria which regulate the selection and sequencing of the operations that are active (Davis, 2011b).

The relationship between objects and operations can be explained using morphisms, where teachers use models to represent mathematical objects. Morphisms provide additional data about the recontextualising principle, i.e. how knowledge was recontextualised for this particular group of learners. The recontextualising principle relates back to distribution of knowledge. For this case study, what this group of learners are getting in terms of the constitution of mathematics.

Chapter 3 has provided a description of the theoretical framework within which this study is located. Following on from the discussion on the theory, I proceed to Chapter 4 which describes the analytic framework for the production of data.

# Chapter 4: The Analytic Framework for the Production of Data

Following on from the theoretical framework described in Chapter 3, this chapter describes the procedures used for the analysis and production of data from four mathematics lessons presented to deaf learners in grades 4, 5 and 6. Table 4.1 shows an overview of the grades, topics and duration of the lessons.

**Table 4.1 An overview of the Lessons**

| Grade | Lesson Topic | Teacher | Number of learners | Duration of lesson |
|---|---|---|---|---|
| 4 | Integers (Lesson 1) | Mrs N | 6 | 01:24:47 |
| 4 | Integers (Lesson 2) | Mrs N | 6 | 00:44:09 |
| 5 | Time | Mrs N | 9 | 00:59:01 |
| 6 | Fractions | Mr L | 6 | 01:29:45 |



As Table 4.1 indicates, two lessons were presented on the topic of *integers*, one lesson was presented on *time* and another on *fractions*. The lessons were presented by two teachers, referred to as Mrs N and Mr L. Appendix G and H contain the transcripts and analyses for lessons one and two on *integers* respectively. The transcripts for the lessons presented to grades 5 and 6 learners are contained in Appendix I and J respectively.

The chapter is introduced by a brief discussion on the background of the pedagogic site as well as the information collection procedure. A detailed discussion of the analytic framework for the production of data ensues. The analytic framework provided the structure for the production of data, in order to answer the research questions of *what* is constituted as mathematics and *how* for this particular group of learners.

## 4.1 Research Design

### 4.1.1 The pedagogic site

The research design is described as an ethnographic case study as the participants were observed in their regular education environment (Mouton, 2001). The pedagogic site for the study was a school for learners who had varying degrees of deafness. The learners did not present with any other sensory disabilities, such as visual impairment. The learners were taught in sign language as they were unable to hear a spoken language such as English or Xhosa. The school was situated in an African township and all the learners were from a low socio-economic background. Most of the learners hailed from surrounding township areas. It was generally the case that learners were not exposed to sign language prior to coming to the school. Their education, therefore not only focused on delivering the curriculum, but also on developing a first language, that of sign language.

### 4.1.2 Information collection procedure

Brown and Dowling (1998: 80) distinguish between information and data. Data is information that is produced from a reading in terms of a theoretical framework. This section describes how the information was collected for the production of data. As shown in Table 4.1, four mathematics lessons were observed from grades 4 to grade 6. The observed lessons were video-recorded using two cameras—one focused on the teacher, the other focused on capturing the activities of the learners. Initially, the teachers were in favour of having their lessons recorded, however they later indicated that they were no longer prepared to do so. The lessons were eventually recorded after much persuasion from the researcher. The raw data consisted of the recorded lessons and the transcripts thereof.

The video material, which was predominantly in sign language, was translated into English. The sign language was translated into English by the researcher, who had been using the sign language at the school for six years. The translations were verified by a teacher who also worked in a sign language environment, as well as an unaccredited sign language interpreter, who worked in the corporate sector. In some instances, teachers also used oral language such as English or Xhosa in conjunction with signing. The oral languages spoken by teachers or learners were translated from Xhosa to English where necessary.

## 4.2 The analytic framework for the production and analysis of data

The purpose of the analysis was to generate data for the purpose of making statements about *what* was constituted as mathematics in the particular pedagogic context and *how*. Based on the theoretical framework developed in Chapter 3, the data and analysis was produced by analysing the operational activity of the teachers and learners. Because the constitution of mathematics is concerned with criteria that come to be and are operational within pedagogic practice (Davis & Johnson, 2007), the data will be produced based on the scriptural practices of teachers and learners. The production of data is concerned with descriptions of the operational activity with respect to the objects and operations that emerge within the pedagogic context. The next section will detail the procedure for the analysis and production of data.

### 4.2.1 Segmenting lessons into evaluative events

The concept of the evaluative event was developed by Davis (2001, 2003) and is recognised as the unit of analysis for investigating the constitution of mathematics in pedagogic contexts. The purpose of the evaluative event is:

> "…to partition records of pedagogic situations (video and transcripts of the speech of teachers and their learners) into segments that are homogeneous with respect to the mathematical topic and the particular activity that participants in the pedagogic situation are engaged in". (Davis, 2011a: 98)

The evaluative event can be described as the time unit which frames the generation of criteria for a specific mathematical topic or content (Davis, 2001). The use of the evaluative event has been adopted and recontextualised by other researchers in their investigations of the constitution of mathematics within various pedagogic contexts (Pillay, 2006; Talasi, 2007; Parker, 2008; Adler, 2009; Jaffer, 2009; Basbozkurt, 2010). Segmenting the transcripts into evaluative events allowed for the lesson to be partitioned into smaller analysable units based on the topic or activity in which the learners were engaged (Davis, 2011). A particular evaluative event commenced when the teacher introduced a particular topic or content and developed it over time. An evaluative event was terminated with the realisation of the content in some final form which, however may be further elaborated on in subsequent lessons (Davis, 2011a). A subsequent evaluative event commenced when there was a new object of learning or new content. An evaluative event therefore consisted of some form of pedagogic activity where content was presented in its initial form and terminated with the realisation of the content in its final form. Evaluative events were also described in terms of the pedagogic activity that teachers and learners were engaged in (Davis, 2011a). For example, one evaluative event may contain a teacher expositing on the addition of fractions while another evaluative event provides a time frame for learners doing a group activity on the addition of fractions. An evaluative event thus produced a time-frame for the pedagogic activity of the teacher and learners with respect to the content.

In some instances, evaluative events consisted of sub-events which were embedded in the main event. Sub-events occurred when the teacher diverted from the main topic in order to refer to content related to, but not central to the main topic of the evaluative event (Davis, 2011a). The purpose of the sub-event was usually to assist learners in acquiring the content of the main event. Evaluative events varied in the amount of time that a teacher allocated to a particular content or topic. Lessons varied in terms of the number of evaluative events contained within the lesson.

**Table 4.2 Segmenting a lesson into evaluative events and sub-events**

| Evaluative Event | Content | Description | Duration | Time |
|---|---|---|---|---|
| 1. | Ordering of integers through three worked examples | Review | 00:06:30 | 00:00:00-00:06:30 |
| 1.1 | Two positive integers: +2 and +6 | Review | 00:03:42 | 00:00:00-00:03:42 |
| 1.2 | Ordering 0 and -3 | Review | 00:01:53 | 00:03:42-00:05:35 |
| 1.3 | Two negative integers: -2 and -7 | Review | 00:00:55 | 00:05:36-00:06:30 |
| 2. | Ordering sequences of integers using three worked examples | Review | 00:13:41 | 00:06:31-00:20:12 |
| 2.1 | Example 1: -3, -2,-1, 0, _, _, _ | Review | 00:01:41 | 00:06:31-00:08:12 |
| 2.2 | Example 2: -4, -2, 0, _, _, _ | Review | 00:02:39 | 00:08:13-00:10:52 |
| 2.3 | Example 3: 11, 7, 3, _, _, _ | Review | 00:09:19 | 00:10:53-00:20:12 |
| 3. | Addition of integers through four worked examples | Review | 00:12:00 | 00:20:13-00:32:12 |
| 3.1 | Two positive integers +5 and +2 | Review | 00:01:05 | 00:20:13-00:21:18 |
| 3.2 | A positive and negative integer: +5 and -2 | Review | 00:03:49 | 00:21:19-00:25:08 |
| 3.3 | Two negative integers: -5 and -6 | Review | 00:02:42 | 00:25:09-00:27:51 |
| 3.4 | A positive and negative integer: -4 and +6 | Review | 00:04:20 | 00:27:52-00:32:12 |
| 4. | Marking of problems given as homework | Review | 00:11:56 | 00:32:13-00:44:09 |

Table 4.2 shows an example of a lesson divided into evaluative events and sub-events. As the table indicates, the lesson was divided into four evaluative events. The sub-events consisted of worked examples related to the topic of the event. For example, the content of the first evaluative event was the ordering of integers. The three worked examples reviewed were related to that content and comprised the three sub-events.

### 4.2.2 Describing the pedagogic activity

Once the lesson transcripts were divided into evaluative events and sub-events, each of these were described in terms of the pedagogic activity occurring within the particular time-frame. Pedagogic activities were described as:

- Expository—where the teacher explained new information or content. New content was elaborated by providing definitions, explanations or through doing worked examples.
- Review—where the teacher reviewed homework exercises completed by learners.
- Assessment—where students completed a mathematics test or quiz. Assessments were completed in signing or in writing.
- Investigative—where students investigated mathematics content through structured tasks and thereby constructed knowledge themselves.
- Discussion: Describes a series of questions and answers between the teacher and learners which involved a discussion regarding the mathematical content.
- Exercises—where learners were required to complete a given a set of problems on their own or in groups.
- Marking—where the teacher marks learners' classwork or homework exercises.

### 4.2.3 Operational activity

Once the lessons were segmented into evaluative events in terms of clusters of content, the next stage in the analysis was to perform a more detailed analysis of the pedagogic activity. This required a description of the operations and operation-like manipulations that were employed as well as the collections of objects on which the operations were performed (Davis, 2011a). Davis (2011a) specifies that operations are functions working in a predictable manner. A function is a relation that produces a unique output for a given input. The manner in which the objects and their operations and/or operation-like manipulations were analysed and described will be detailed in the following section where a teacher produced a procedure for adding two integers.

The following transcript is taken from a lesson presented to grade 4 learners where the topic is *integers*. During the particular evaluative event, the teacher produced criteria for adding integers, by considering the symbols of the arguments, i.e. whether the symbols were positive or negative. The teacher considered the symbols contained in the example: $+2 + +4 = +6$:

> 737. T[2]: This one (Points at problem) has positive, positive, positive. They are the same which means it will stay positive.

The following extract was taken from a sub-event, which consisted of a worked example to exposit on a procedure for the addition of a positive and negative integer. The teacher wrote "$-8 + +4 = -4$" on the board, then signed the following:

> 741. T: Here (Points at -8) negative eight plus positive four. (Points at -8) Eight is what? It is big. Four is what? It's small. Now, it's important to look at the sign of the big number. Which is it? Look, it's negative. Why? Here (Points at-4). Now because you add, the sign is negative. (Points at -8) here eight minus four is four. Do you hear? Good.

The teacher's criteria for adding a positive and negative integer taken from the transcript can be written in a series of steps as shown below:

1. Consider the symbols (+, -) attached to the numerals. If they are not identical, i.e. either both positive or negative, detach the signs from the numerals: 8 and 4. This step transforms the integers into whole numbers.
2. Determine the smaller and larger between the two whole numbers: 8.
3. Determine the symbol attached to the larger number: -.
4. Subtract the smaller  whole number from the larger one: 8-4=4
5. The symbol of the larger "whole number" is joined to the difference calculated between the two whole numbers to produce the solution:-4.

[2] "T" refers to the signing of the teacher.

The teacher's criterion to "look which number is big", created ambiguity as she considered the expressions /-8/ and /+4/ as whole numbers (/8/ and /4/) with signs, rather than as integers (/-8/ and /+4/). The numerals were taken apart from the signs then recoupled to them. The implication is that an integer is a whole number with a sign attached to it, which is not mathematically sound. An operation-like manipulation termed "sundering" is used to describe the operation of splitting the numerals from the symbols (Davis, 2009). The procedure starts with the addition of integers ($\mathbb{Z}, +$), which shifts to that of subtraction of whole numbers ($\mathbb{N}_w$, -). The last step glues the symbol to the numeral which is described as concatenation (Davis, 2009 in Jaffer, 2009). This example is similar to one described by Davis (2010a), where the teacher's use of the word "number" in the procedure refers to computation on whole numbers. The whole numbers were then changed back into integers. The teacher's procedure seems motivated by a desire to work with a more familiar domain such as whole numbers.



The diagram shown in Figure 4.1 is based on a similar procedure for adding integers, described by Davis (2010a). Figure 4.1 is useful for showing the input objects, output objects, the changes in the domains and the operations performed on the objects.

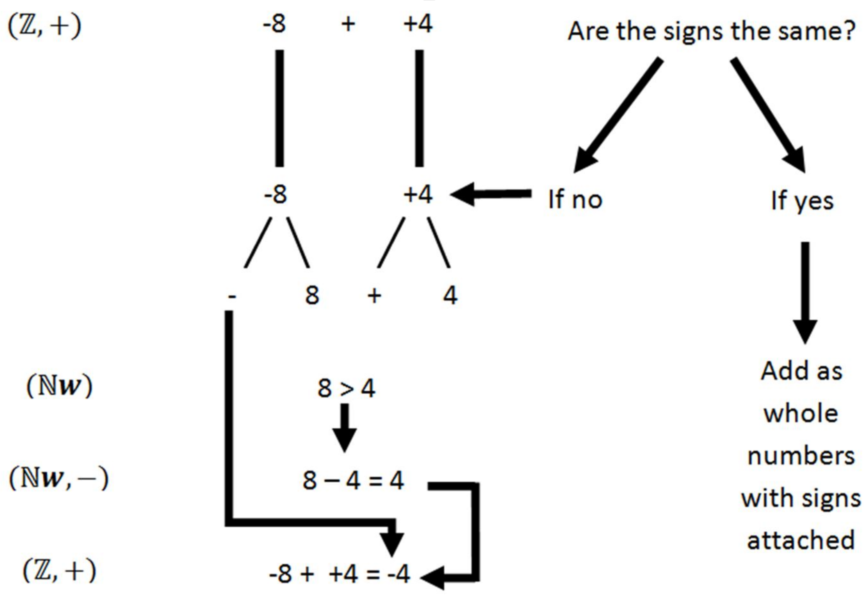


**Figure 4.1 A teacher's procedure for adding integers: $-8 + +4 = -4$**

As Figure 4.1 shows, the teacher's procedure entails a series of steps. The topic was implicitly announced as "integers" through the teacher's spoken language. The mathematical objects of integers were treated as characters. The operations performed over the objects were described as operation-like manipulations where the bits of the characters were split apart and later glued back together. The domain of integers was shifted to whole numbers, were operated on, and then shifted back to whole numbers. The procedure required a number of operations and operation-like manipulations in order to produce the solution of -8 + +4. The objects and operation-like manipulations described here are not referenced in the mathematics encyclopaedia.

### 4.2.4 The character distribution matrix

Davis and Johnson (2010: 144) define a character distribution matrix as a “pedagogic resource for the regulation of the mathematical activity based on the use of very particular spatial distributions of symbols in the organisation and presentation of transformations from one mathematical expression to another as a solution is generated according to a procedure”. As their definition suggests, a character distribution matrix consists of symbols or characters which are organised in a particular way, based on a specific procedure. They concluded that the use of a character distribution matrix produced solutions which were not mathematically generated but were, rather the spatial distribution of symbols which were formatted in the form of a particular procedure. The solutions were presented in the form of a template, where the iconic features of mathematical expressions were emphasised.

An example of a teacher’s use of a character distribution matrix in his pedagogic practice, occurred during a grade six lesson on fractions. The teacher’s objective was to represent the fraction $\frac{3}{8}$. To produce the fraction, his main resource was a diagrammatic representation of “cake”. The “cake” was represented as a circle which the teacher divided into eight segments. A learner was called up to shade three segments, as shown in Figure 4.2.

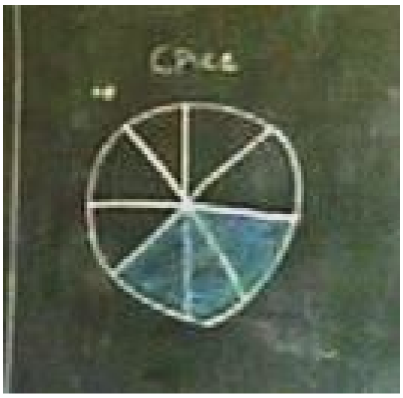

**Figure 4.2 A representation of “cake”, showing shaded portions**

The following extract is taken from the lesson after the three segments of "cake" were shaded in blue and indicates the teacher's criteria for producing the fraction.

269. T: How many have colour? [*T is referring to segments shaded in blue*][3]

270. Ls: There are …it's there.

271. Ln: There are three.

272. T: Look here (Points at the drawing of the cake).

273. Ln, Lv: (Tell Ls) There are three.

274. Ls: There are three.

275. T: Look here. Three? What three?

276. Ls: There is one. There is one.

277. Lp: With colours.

278. T: What is there?

279. Ls: There's one in the colour red. [*Learner may be referring to a previous example*].

280. Lp: There are three in colour (To Ls).

281. T: (Writes "= $\frac{3}{\phantom{8}}$"). [*The numerator refers to the cardinality of shaded parts*]. How many altogether? [*Count the total number of parts*].

282. Ll, Lv: Eight. [*These learners are able to count the total number of parts*].

283. Ln: Five.

284. Lp: Five. [*These learners are counting the number of unshaded parts*].

285. T: (Writes 8 below the line). [*The denominator refers to the cardinality of the total number of parts*]. Do you understand, understand?

Figure 4.3 shows the "cake" with shaded segments as well as the teacher's representation of the fraction $\frac{3}{8}$ using the shaded segments and the total number of segments.

[3] Round brackets were used in the transcript to describe the activity of the teachers and learners. Comments regarding the transcript are contained in square brackets and are italicised.

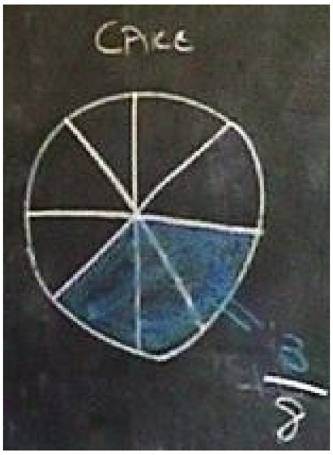


**Figure 4.3 A fraction generated from shaded and total number of parts**

The teacher produced a procedure for generating a fraction which is described in the following steps:

Step 1: Segment an object into parts.

Step 2: Use shading to demarcate parts to be counted.

Step 3: Determine the cardinality of shaded parts: 3

Step 4: Write the natural number as the numerator in the template: $\frac{3}{\phantom{8}}$

Step 5: Count the total number of parts: 8

Step 6: Write the natural number as the denominator: $\frac{3}{8}$

The teacher's procedure for producing the fraction employed the use of an operation which has been termed "spatial distribution", denoted as "$d_s$". Criteria for generating the fraction required the learners to, first count the number of shaded parts and arrange the cardinality as the numerator ($a$) in a template $\frac{a}{b}$. The total number of portions was counted (8) and written as the denominator ($b$). The teacher did not refer to the number of shaded portions to the whole as a proportion or comparison. Rather, the fraction was generated using a procedure whereby numbers were spatially arranged as characters in a particular template, where one number was written above the other. The operation of spatial distribution was so termed due to the stable manner in which the parts were counted and the cardinality arranged in a specific form. As explained by Johnson and Davis (2010), the rules producing the character distribution matrix in the above example prescribed computations which were not mathematically relevant to the topic indexed, but rather emphasised the spatial distribution of characters based on their iconic features. The teacher's exposited procedure, and his use of the operation termed "spatial distribution" is not referenced in the mathematics encyclopaedia.

Johnson and Davis (2010) refer to a character distribution matrix as a pedagogic regulatory mechanism as this form of pedagogic practice produces regulatory texts. Regulatory texts "construct the kind of practice for which principles are relatively implicit, which is to say not so readily available within the discourse" and are in contrast to transmission texts where the principles are readily available within the pedagogic practice (Dowling & Brown, 2000: 252).



### 4.2.5 Morphisms

As stated in Chapter 3, teachers often made use of metaphors or analogies in order for learners to make meaning of mathematical notions. The use of metaphors can be described in terms of morphisms which map represented systems to representing systems. This section will detail how the concept of the morphism was applied to an example used by a teacher to generate data for the study. Based on the example, a corresponding external diagram (shown in Figure 4.4) represented the objects, whether physical or mathematical that was made available. The operations performed over the objects as well as the mappings between the objects were determined, which produced data for the study.

Figure 4.4, based on the example described in section 4.2.4, shows the morphism where the segments of "cake" were mapped to numerical values in order to represent a fraction $\frac{3}{8}$.

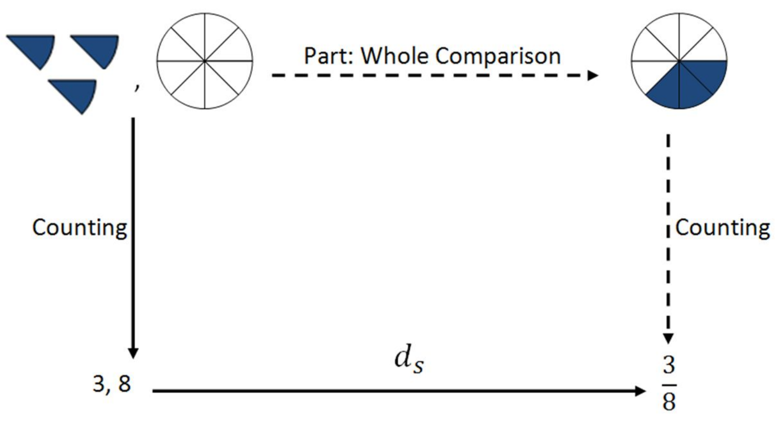


**Figure 4.4 A morphism mapping segments of "cake" to a fraction**

The diagram shows the inputs which are the number of shaded segments and the total number of segments. The output when the operation is part: whole comparison is a graphical representation of proportion showing three parts out of eight parts. When the counting function is performed on the graphical representation of the proportion, the fraction $\frac{3}{8}$ is produced. Another way to produce an output of $\frac{3}{8}$ is to perform the counting function on the number of shaded segments and the total segments to produce the cardinal values of 3 and 8. These values are written as the fraction $\frac{3}{8}$ through an operation which has been termed "spatial distribution". The operation was applied in a specific and fairly constant way by the teacher, where shaded parts were first counted and the cardinality represented the numerator. The total parts were counted and the cardinality represented the denominator. The shaded parts of cake, the whole and the graphical representation of the proportion was the representing system used to represent the represented system. The represented system was the numerals 3 and 8, the fraction $\frac{3}{8}$ as well as the operation of spatial distribution ($d_s$).

As the example shows, morphisms are useful analytical resources for describing the teacher's criteria, the objects made available and the operations employed over them. Analysis of the teacher's example of "cake" (described in sections 4.2.4 and 4.2.5) shows that the fraction $\frac{3}{8}$ was not produced through a comparison between the part and the whole. Rather, the teacher prioritised the spatial arrangement of numerals in a specific template. The morphism also shows that the criteria regarding a fraction as a part: whole comparison (shown by the broken arrows) was implicit. His exposition more explicitly showed the path down then across which emphasised the operation of spatial distribution.

### 4.2.6 The use of time

Segmenting the lessons into evaluative events, provided valuable data in terms of the amount of time spent on particular pedagogic activities. Some examples of pedagogic activities which the teacher and learners may be engaged in include exposition of mathematical principles and definitions, exposition through worked examples or learners working through exercises (Davis & Johnson, 2007). Analysing the use of time during the lessons will highlight the pedagogic activities that are prioritised in terms of the amount of time spent on them. Section 4.2.2 provides descriptions of the pedagogic activity occurring during evaluative events.

The analytic framework described in this chapter provided a structure for the analysis and production of data for the study. The data production enabled me to generate statements about the constitution of mathematics inherent in the teachers' pedagogic practices. Following on from the production of data using the analytic framework discussed in this chapter, Chapters 5 and 6 will detail the analyses and data production for the lessons presented on the topics of *integers* and *fractions*. Due to constraints on space, the analyses of the lesson presented on the topic of *time* is contained in Appendix K. This lesson provides additional data regarding the teacher's pedagogic practice, however was not central to the study as one lesson topic taught by each teacher was analysed and provided sufficient data regarding each teacher's pedagogic practice. This chapter concludes with a discussion about the reliability and validity of my study as well as ethical considerations.



### 4.3 Reliability and validity of the study

The study's reliability rests in its dependence on the essential properties of mathematics. These essential properties of mathematics cannot change in different contexts, for example the field of production, recontextualisation and reproduction. The use of the essential properties of mathematics thus lends stability and reliability to the results. The study's validity and reliability lies in the fact that the data was obtained from classroom observation, which was an accurate reflection of the pedagogic practice of teachers and learners. The validity could have been enhanced through triangulation of the results by conducting interviews with the teachers and learners, or by doing a survey with the teachers. However, as indicated earlier, the teachers were not fully cooperative in having their lessons observed and may not have agreed to interviews. The reliability of the sign language translation may be questioned as the lessons were not transcribed by an accredited interpreter, however the researcher feels confident that her translations, which were verified by others familiar with sign language, is an accurate account of the signing used.

### 4.4 Ethical considerations

Voluntary informed consent is an essential notion for the protection of human research participants (Nelson et al, 2011). Prior to the collection of data, written permission was received from the Department of Education, the school principal, as well as the teachers involved to proceed with the research. Written permission was also granted from the parents of the learners.

As far as possible, researchers need to ensure that they do not disclose identifiable information about participants. Research participants need to remain anonymous in order to protect their right to privacy or confidentiality (Wiles et al, 2006). The participants' identities were not disclosed during the research process in order to protect their rights to confidentiality and anonymity. In the lesson transcripts, the letter "T" was used to denote signing by the teacher. The letter "L" was used to refer to learners. Full names were not used. The name of the school was not disclosed in the research process.

Ethical standards dictate that, based on the researcher's observations, these lessons should not have been allowed to continue and appropriate intervention should have occurred. The researcher was presented with a moral-ethical dilemma. However, for the purposes of research, it was necessary to allow the lessons to continue in order to gain an accurate representation of the teaching and learning occurring in these classrooms. The lessons authentically presented the knowledge distributed to these learners.

# Chapter 5: Data Production for Grade Four Lessons on *Integers*

As previously stated, the aim of the current study is to describe *what* gets constituted as mathematics and *how* in four lessons presented to a group of deaf learners. This chapter will present the production of data for two lessons presented to grade four learners on the topic of *integers*. The lessons were presented in sign language by Mrs N.

## 5.1 Overview of the lessons

An examination of the Revised National Curriculum Statements (RNCS) (Department of Education, 2002b) revealed that the topic of *integers* was not part of the curriculum for grade four. The term *integers* is first mentioned as a minimum requirement in the grade seven curriculum statements. As stated in Chapter 1, the current policy regarding special needs education stipulates that all children, regardless of disability, have access to the same curriculum. The chosen topic should not have been presented to this group of grade four learners.

The two lessons presented on *integers* were divided into evaluative events and sub-events. Tables 5.1and 5.2 provide a brief description of the content of the evaluative events, sub-events as well the duration for lessons one (L1) and two (L2) respectively.

Table 5.1 indicates that during the first lesson, Mrs N focussed on four sections pertaining to integers. Firstly, she defined the set of integers. She proceeded to ordering integers by expositing on the use of inequality symbols to integers and then applying the symbols to three examples. She used three examples of sequences of integers where she required learners to fill in the missing integers. The last evaluative event focused on the addition of integers. At the end of the first lesson, Mrs N gave the learners exercises to complete for homework. The evaluative events of L1 were all described as “expository” as new information or content was explained by the teacher. The subsequent lesson on integers focussed on producing the solutions to the homework exercises.

**Table 5.1 Evaluative events and sub-events of lesson one (L1) on *integers***

| Evaluative Event | Content | Description | Duration | Time |
|---|---|---|---|---|
| 1. | Defining the set of integers | Expository | 00:06:21 | 00:00:00-00:06:21 |
| 2. | Ordering integers using worked examples | Expository | 00:18:49 | 00:06:21-00:25:10 |
| 2.1 | Representing ordering using the inequality symbols | Expository | 00:01:12 | 00:06:21-00:07:33 |
| 2.2 | Two positive integers: $+5$ and $+3$ | Expository | 00:02:37 | 00:07:33-00:10:10 |
| 2.3 | A positive and negative integer: $-4$ and $+2$ | Expository | 00:05:32 | 00:10:10-00:15:42 |
| 2.4 | Two negative integers: $-7$ and -2 | Expository | 00:09:28 | 00:15:42-00:25:10 |
| 3. | Ordering sequences of integers through three worked examples | Expository | 00:18:04 | 00:25:10-00:43:14 |
| 3.1 | Example 1: $-12, \; -11, -10, \_, \_, \_$ | Expository | 00:09:52 | 00:25:10-00:35:02 |
| 3.2 | Example 2: $2 \; -2, -1, 0, \_, \_, \_$ | Expository | 00:03:41 | 00:35:02-00:38:43 |
| 3.3 | Example 3: $-6, \_, 4, -2, 0, \_, \_, \_$ | Expository | 00:04:31 | 00:38:43-00:43:14 |
| 4. | Addition of integers through four worked examples | Expository | 00:28:20 | 00:43:15-01:11:34 |
| 4.1 | Two positive integers: $+2 + +4 = +6$ | Expository | 00:03:43 | 00:43:14-00:46:57 |
| 4.2 | A positive and negative integer: $+6 + -2 = +4$ | Expository | 00:07:42 | 00:46:57-00:54:39 |
| 4.3 | Two negative integers: $-3 + -5 = -8$ | Expository | 00:04:10 | 00:54:39-00:58:49 |
| 4.4 | A positive and negative integer: $-8 + +4 = -4$ | Expository | 00:12:45 | 00:58:49-01:11:34 |
| 5. | Learners write down their homework exercises | | 00:13:13 | 01:11:34-01:24:47 |

Table 5.2 presents the evaluative events and sub-events making up the second lesson. The examples given as homework exercises were similar in content to those presented in the first lesson. The examples focussed on order relations between integers, producing the missing integer in a sequence of integers and the addition of integers. The evaluative events of this lesson were described as "review" as the teacher and learners reviewed the solutions produced for the homework exercises.

**Table 5.2 Evaluative events and sub-events of lesson two (L2) on *integers***

| Evaluative Event | Content | Description | Duration | Time |
|---|---|---|---|---|
| 1. | Ordering of integers through three worked examples | Review | 00:06:30 | 00:00:00-00:06:30 |
| 1.1 | Two positive integers: $+2$ and $+6$ | Review | 00:03:42 | 00:00:00-00:03:42 |
| 1.2 | Ordering $0$ and a negative integer: $-3$ | Review | 00:01:53 | 00:03:42-00:05:35 |
| 1.3 | Two negative integers: $-2$ and $-7$ | Review | 00:00:55 | 00:05:35-00:06:30 |
| 2. | Ordering sequences of integers using three worked examples | Review | 00:13:42 | 00:06:30-00:20:12 |
| 2.1 | Example 1: $-3, -2, -1, 0, \_, \_, \_$ | Review | 00:01:42 | 00:06:30-00:08:12 |
| 2.2 | Example 2: $-4, -2, 0, \_, \_, \_$ | Review | 00:02:40 | 00:08:12-00:10:52 |
| 2.3 | Example 3: $11, 7, 3, \_, \_, \_$ | Review | 00:09:20 | 00:10:52-00:20:12 |
| 3. | Addition of integers through four worked examples | Review | 00:12:00 | 00:20:12-00:32:12 |
| 3.1 | Two positive integers $+5$ and $+2$ | Review | 00:01:06 | 00:20:12-00:21:18 |
| 3.2 | A positive and negative integer: $+5$ and -2 | Review | 00:03:50 | 00:21:18-00:25:08 |
| 3.3 | Two negative integers: $-5$ and $-6$ | Review | 00:02:43 | 00:25:08-00:27:51 |
| 3.4 | A positive and negative integer: $-4$ and $+6$ | Review | 00:04:21 | 00:27:51-00:32:12 |
| 4. | Marking of problems given as homework | Review | 00:11:57 | 00:32:12-00:44:09 |

When referring to a particular sub-event, that particular event will be denoted as either occurring in Lesson 1 (L1) or Lesson 2 (L2). Evaluative events will be referenced as EE followed by the number of the particular sub-event, e.g. L1EE3.2 refers to lesson one, evaluative event 3 and sub-event 2.

### 5.2 A note on the signing used by the teacher

The teacher used contradictory signs during the lesson. For example, she used the sign for "same" instead of "different" when expositing on the symbols of the integers, which caused confusion. Her meaning was made apparent to the researcher through her spoken language, however the learners were unable to hear her Xhosa speech.

The teacher used the sign for “who” instead of “what” when referring to objects as shown in the following examples from the transcript:

654. T[4]: Who do we add?

658. T: Now, who is three plus five?

**5.3 The announcement of the topic**

The topic name was explicitly announced by Mrs N’s writing on the chalkboard when the lesson commenced. The topic name was absent in her signing to the learners, as Mrs N may not have known the sign for this mathematical term. The learners were probably not aware of the meaning of the word written on the board. Later in the lesson, she used the term “integer” in her spoken language and simultaneously fingerspelled[5] the letter “I” to refer to the term. The learners may not have recognised what the fingerspelling referred to as they were not introduced to the topic. Specialised mathematical terms in sign language do exist as many online dictionaries using American Sign Language, have signs for mathematical terms.



**5.4 Production of data and analysis**

The data for the lesson was constructed using the analytical framework described in Chapter 4. The data production commenced with an examination of the criteria, in terms of the objects and operations presented in each evaluative event and sub-event. From the criteria, the operational activity of the teacher and learners was described. The objects employed, as well as the operations performed over them, will be explicated in the following sections. Morphisms, which were described in Chapter 3 (section 3.3.4), will be applied to examples where relevant. The use of character distribution matrices will be presented where applicable.

**5.4.1 Defining the set of integers**

During the first evaluative event in L1, Mrs N. defined the set of integers as a collection of two distinct groups of objects. One group consisted of positive numbers and the other consisted of negative numbers. Figure 5.1 shows the primary opposition she used to describe integers.

[4] The letter “T” refers to the words signed or spoken by the teacher.
[5] Chapter 1 (section 1.3.2.1) provides an explanation on fingerspelling.

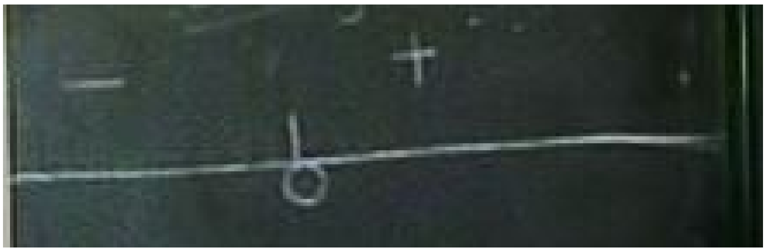

**Figure 5.1 A teacher's description of integers in terms of positive and negative signs**

Mrs N used a number line to indicate where positive and negative numbers were located in relation to zero as shown in Figure 5.2.

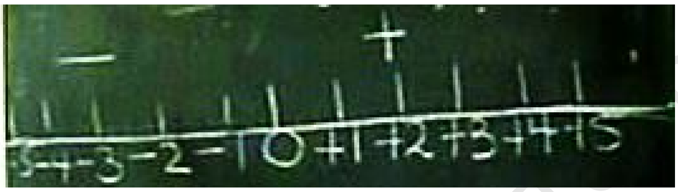

**Figure 5.2 A number line showing the position of the integers in relation to zero**

With reference to the number line, Mrs N stated the following:

> 24. T: All these (pointing at positive numbers) are big. Which means they are greater than zero. All the numbers that have positive are greater than zero. Do you hear? I'm saying all… you (refers to Ln)[6] all the numbers that are positive, positive, positive say what? It's bigger than who? Zero. Do you hear? All the positive numbers are what? Positive, positive, positive. Meaning it's bigger than what? Zero. Do you hear?

While pointing at the left side of the number line comprising negative numbers, she stated that:

> 26. T: (Pointing at left side of number line). These numbers are small. They are below zero. All the numbers that have a negative, negative sign are less than and below zero. All the numbers that have negative are small and less than zero. All the numbers that are negative, are small and below what? Zero.

The diagram in Figure 5.3 represents Mrs N's criteria for defining the set of integers (ℤ).



[6] The labels of Lv, Lz, Ll, Ln, Lu and Ly refers to the signing or speech of individual learners. Here, the teacher is addressing a learner, Ln.

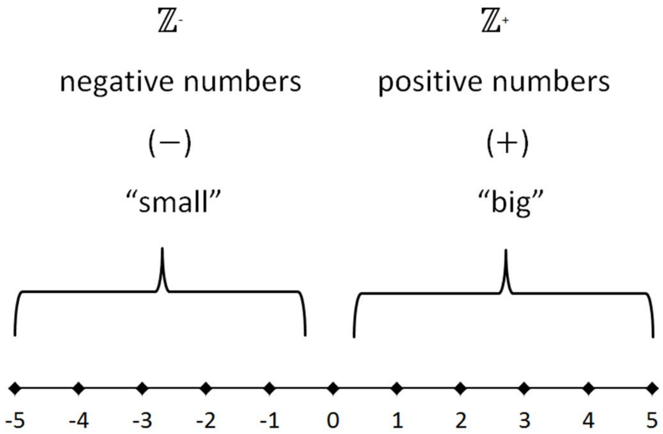


**Figure 5.3 A teacher’s definition of integers**

The teacher’s criteria indicated that the set of integers consist of two collections of numbers, positive ($\mathbb{Z}^{+}$) and negative ($\mathbb{Z}^{-}$) numbers. The terms “positive” and “negative” seem to be synonymous with “big” and “small” with reference to numbers where a positive number has the global quality of being big; a negative number, of being small. In other words, if *n* “has” +, then *n* is “big” and “more than zero”. If *n* “has” -, then *n* is “small” and “less than zero”. According to Mrs N’s criteria: $\mathbb{Z}^{+} \subset \mathbb{Z}$ and $\mathbb{Z}^{-} \subset \mathbb{Z}$. However, $\mathbb{Z}^{+} \cup \mathbb{Z}^{-} \neq \mathbb{Z}$, as zero should have been included in her definition of integers. $Z^{+} \cup \{0\} \cup Z^{-} = Z$ shows that zero is excluded from her definition. Zero is represented as a spatial marker which distinguishes positive from negative numbers.

Mrs N’s language to describe the objects was spatial in nature as she used terms such as “in the centre” and “this side” to refer to the numbers on the number line as well as “below zero”. Her use of spatial language may indicate that she views integers as being physical objects which are arranged in a spatial frame on the number line.

In summary, integers were defined as consisting of two subsets, $\mathbb{Z}^{+}$ and $\mathbb{Z}^{-}$. The subsets were spatially arranged on the number line where “positive” and “negative” numbers were characterised as being “big and more than zero” and “small and less than zero” respectively. Zero was not included as a component of the set of integers. Following on from her definition and description of integers, Mrs N proceeded to the second evaluative event which focussed on the order relations between integers.

### 5.4.2 Order relations between integers

In L1 the sub-topic of *ordering integers* was implicit, as the topic was introduced as being about "big" and "small" which previously referred to positive and negative numbers. The inequality signs /</ and />/ were written on the chalkboard in L1EE2.1, which the learners identified as a "mouth" or "bird's beak". Mrs N then used the learners' representations of a "mouth" which opened and closed as a metaphor to describe the inequality signs. Metaphors are usually used by teachers to assist learners in making sense of mathematical concepts. A difficulty in using metaphors is that, logical mathematical notions are not easily explained by the everyday (Davis, Adler & Parker, 2007). The metaphor exemplified by the teacher had no mathematical foundation and was possibly indicative of the teacher's conceptualisation of the symbols as physical objects. Her criteria that "If the mouth is open, we say it's big. If the other one is closed, it's small" seemed to indicate that the open side of the symbol faced the big number and the closed side faced the small number which is represented as:

small number < big number

Mrs N did not indicate that the inequality signs do not represent big or small independently of numbers. Instead, they are relational symbols which are used to describe comparisons between two numbers. The choice of the sign ("less than" or "more than") is dependent on the order in which the numbers are written and the example $5 > 2$ is the same statement as $2 < 5$.

In L1EE2.2 and L2EE1.1, the learners were unable to order the two positive integers based on the teacher's criterion that "all numbers that have a positive sign are big". She did not explain that numbers within the set of positive numbers could be compared to each other. She was reliant on their knowledge of whole numbers to do the ordering. Her criteria were able to work for the example given in L1EE2.3 for the ordering of a positive (+2) and negative integer (-4), as the positive symbol was synonymous with "big" and the negative symbol with "small". The learners were able to order the example of 0 and -3 in L2EE1.2 based on their knowledge of the number line.

In L1EE2.4, the learners were unable to order the two negative integers (-7 and -2), due to the teacher's criterion that all negative numbers were small. Mrs N modified her criteria using the number line and stated the following:

238. T: Look at this (Points at 0 on number line). This (Points at 0 and 1). It's opening. This (points at 0). It's closed. From zero to positive one, it opens a little. Now, to go from positive one to positive two, it opens a little. Now, to go again from there to positive three, it opens. From zero to positive four, it opens. It opens and gets wider and wider. From zero to all positive numbers.

Her revised criteria seemed to indicate that the "mouth" of the inequality signs between the positive integers opened wider as the positive number increased. The "mouth" opened wider as the numbers increased from zero to all positive numbers. She stated the following about negative numbers:

239. T: Now, we come to this side (Points from 0 to left side of number line). Now, remember this (points at 0) is zero. This (Points at -1) is big [*Contradicts previous criterion that negative numbers are small*][7]. This (Points at 0). From here (Points at 0) to here (Points at place after +5) it's closed then it opens wider, wider and wider till it's open and big. Now, from here (Points at 0) to here (Points at -5). From zero, it's big! Zero is big. (Points at 0 then -1) it's big. Then it gets smaller and smaller. (Points at 0 then -2), it gets smaller. (Points at 0 then -3), it gets even smaller. (Points at 0 then -4), it's even smaller. (Points at 0 then -5), it gets very small. This means negative one is very big!

For the negative integers, the "mouth" seemed to be decreasing in size. Mrs N's criteria regarding the inequality signs are depicted in the number line shown in Figure 5.4.

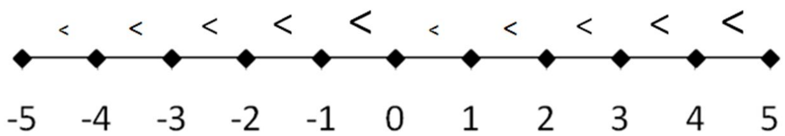


**Figure 5.4 The teacher's criteria regarding the inequality signs**

As Figure 5.5 shows, her criteria regarding the inequality signs between the negative integers were incorrect as the numbers to the left of zero were decreasing and the inequality sign should be opening wider as the numbers decrease to the left (See Figure 5.5).

[7] Comments regarding the transcript are italicised and inserted in square brackets.

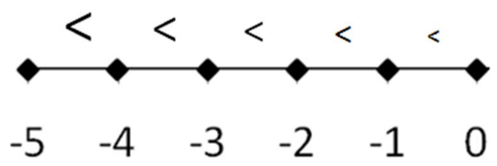


**Figure 5.5 Negative numbers decrease to the left of the number line**

This exposition on the "mouth" implicitly indicated that numbers within the sub-group of positive and negative integers could be compared to each other and that numbers from the two sets $\mathbb{Z}^+$ and $\mathbb{Z}^-$ could be compared. The modified criteria contradicted her previous criteria that all positive numbers were big and all negative numbers were small.

Mrs N labelled the inequality signs as number one (>) and two (<). She required the learners to represent the ordering by "choosing" either one or two. Her labelling of the signs may indicate that she did not know the specialised signs for these mathematical symbols.

In summary, the ordering of integers was represented using the inequality symbols of < and >. Two positive integers were ordered as whole numbers. A positive and negative integer was ordered based on the criterion that positive numbers were synonymous with "big" and negative numbers with "small". Criteria regarding ordering two negative integers were re-stated, using the number line as represented in Figure 5.4, as the previously stated criterion that "negative numbers are small" was not applicable for these examples.

### 5.4.3 Ordering sequences of integers

For the next three examples, the learners were required to complete the sequences of integers. Mrs N did not produce explicit criteria for the ordering, but was reliant on the learners' knowledge of counting as well as their knowledge of the number line for the examples given in L1EE3.1, L1EE3.2, L2EE2.1 and L2EE2.2. The number line was written on the chalkboard in L1 but was not referred to during her exposition on ordering the sequences.

Figure 5.5 shows that the example used in L1EE3.3 created confusion as Mrs N wrote the sequence incorrectly on the board.

**Figure 5.6 Teacher wrote sequence incorrectly**

The manner in which the example was written created confusion, as it was not clear whether the line between -6 and 4 indicated a missing number or whether the line was a negative sign. Mrs N did not realise her error. Her conception may have been that if certain elements of the object were present, she deemed the object as being correct.

For the example in L2EE2.3, the learners were unable to complete the sequence so Mrs N used a number line as a resource to produce criteria for the ordering. The learners were required to count the number of intervals between 11 and 7, as well as the number of intervals between 7 and 3. It was implicit that the operation between the arguments was to subtract 4 or add -4 and that the integers in the sequence represented counting backwards in 4s. Figure 5.7 shows the counting of intervals between the integers, in order to produce the subsequent numbers in the sequence.

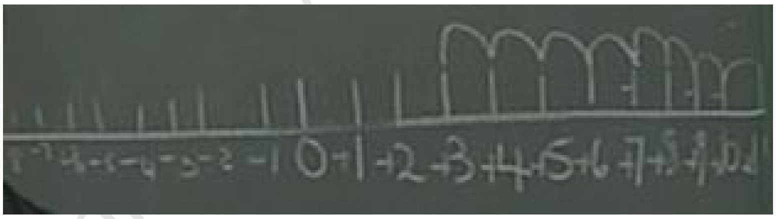

**Figure 5.7 Counting intervals between the integers**

In L2EE2, different learners were called up to complete each of the segments in the sequence which indicated that the teacher relied on the class as a whole to produce solutions rather than individual learners.

Following her worked examples on order relations between integers, Mrs N proceeded on to the next sub-topic which was the *addition of integers.*

### 5.4.4 Addition of integers

At the outset of L1EE4, Mrs N explicitly indicated the operation as addition in her signing, as well as in her writing of "+" on the chalkboard. She generated criteria for adding integers based on whether the arguments of the inputs were both positive, both negative, or a positive and negative integer. The following sub-sections describe her criteria for the various inputs.

#### 5.4.4.1 Adding two positive integers

When she exposited on the addition of two positive integers, Mrs N generated the criterion that when the arguments of an input are both positive integers, the output produced will be a positive integer as shown in the following extracts:

> 589. T: (Points at +2). Positive. (Points at+4). Positive plus positive is what? Positive.
>
> 737. T: This one has positive, positive, positive. They are the same which means it will stay positive.

She used a metaphor of borrowing money to explain the addition of two positive integers as a whole number calculation, where a person firstly borrowed R2 then borrowed R4. The learners were required to produce the total amount borrowed. Figure 5.8 shows a morphism which maps the money borrowed to positive integers, using the function of counting.

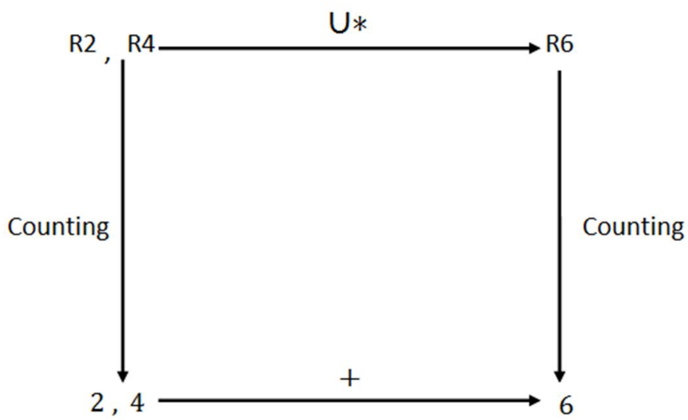


**Figure 5.8 A morphism mapping money to positive integers**

Figure 5.8 shows that the addition of the money borrowed was the representing system used to represent the addition of two positive integers. The operation of the representing system was that of disjoint union (∪*), which was performed over the two sets consisting of R2 and R4 respectively to produce an output of R6. The operation of disjoint union corresponds to the operation of addition due to the counting function as previously shown in an example in Chapter 3 (section 3.3.4). The addition of positive integers was exemplified as a whole number calculation. Based on the criteria generated, the learners were able to produce the required solution in L2EE3.1 as a whole number calculation.

#### 5.4.4.2 Adding two negative integers

The teacher's criterion for adding two negative integers was that when the arguments of the input were negative, a negative integer would be produced as the output, as shown in the following extracts:

643. T: If, if the signs before the numbers are the same, take it like that because they are both negative.

739. T: There is no problem because when you add a negative and a negative, you leave it like that. It is the same.

Her criterion is evidenced by her writing of a negative sign as part of the solution in the example of L1EE4.3, as shown in Figure 5.9 which reads as -3 + -5 = -.

**Figure 5.9 A negative sign was written as part of the solution**

The numerals attached to the signs were then added as whole numbers as shown in the following extract:

650. T: So what do we add? Three.

651. Lz, Ln: Three.

653. T: And who? Five.

The solution to the computation "3 + 5" was then written next to the – symbol as shown in Figure 5.10 which reads as -3 + -5 = -8.

**Figure 5.10 The solution is a negative integer**

Mrs N's procedure for adding two negative integers were:

Step one: Split the signs from the numerals.

Step two: If the signs are the same, write down that sign: $-$.

Step three: Then add the numerals: $3 + 5 = 8$.

Step four: Attach the sign to the number to produce the answer: $-8$.

Figure 5.11 shows the teacher's shifts in domains when adding two negative integers. The procedure starts off with the addition of integers. The domain shifts to that of whole number calculation through the operation-like manipulation of sundering, where the numerals are split from the signs. The domain is shifted back to that of integers through the operation-like manipulation of concatenation, where the sign and the numeral are re-attached.

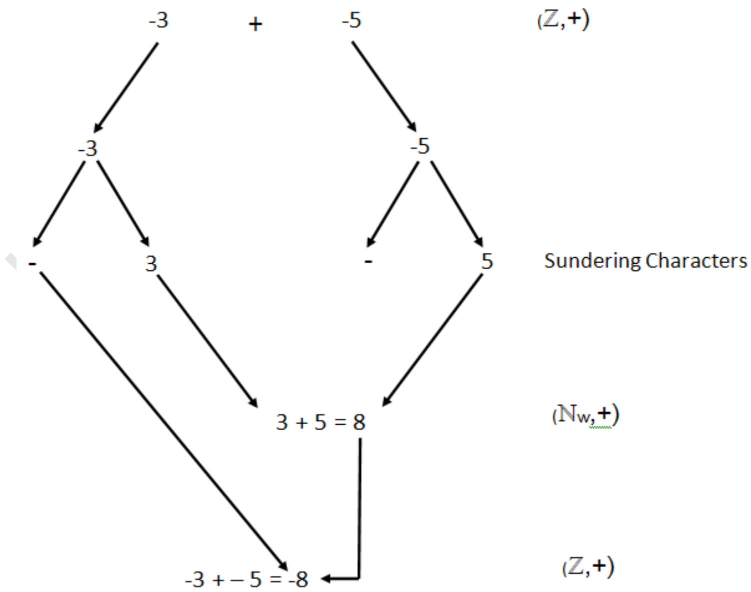


**Figure 5.11 A description of teachers' procedure for adding two negative integers: -3 and -5**

Mrs N's conceptualisation of integers is that of characters, made up of particular bits. The bits are numerals, specifically whole numbers, which are coupled with + and – signs. Her procedure for adding two negative integers can be described as a character distribution matrix where the iconic features of mathematical expressions are exploited for the purpose of generating standard solutions to problems as described by Johnson and Davis (2010). They describe a character distribution matrix as a solution template where steps or rules are employed for the distribution of characters and symbols. A character distribution matrix has been described as a regulatory mechanism where principles of the text remain implicit (Dowling & Brown, 2000). As the example showed, mathematical reasoning around the addition of negative integers is implicit, while the teacher's pedagogy more explicitly shows the spatial distribution of numerals and symbols within a particular template using a specific procedure. Through her procedure, integer addition was transformed into whole number addition. The teacher's treatment of the objects as characters and her use of operation-like manipulations for this procedure, are not referenced in the mathematics encyclopaedia.

The morphism in Figure 5.12 shows how it is possible to achieve a shift in domain from integers to whole numbers through the use of the absolute value function. The teacher effects the shift in domain by using an operation-like manipulation that splits signs from numerals.

$$\begin{tikzcd}
(-3;-5) \arrow[r, "+"] \arrow[d, "f=|x|"'] & -8 \arrow[d, "f=|x|"] \\
(3;5) \arrow[r, "+"] & 8
\end{tikzcd}$$

**Figure 5.12 A morphism mapping $(\mathbb{Z},+)$ to $(\mathbb{N},+)$**

Mrs N applied the same procedure in L2EE3.3 where the solution of -11 was produced by first positioning a negative sign in the solution, then adding the numerals as whole numbers for the example $-5 + -6 =$. The morphism in Figure 5.13 shows the teacher's shift in domain from integers to whole numbers, using operation-like manipulations where the numerals are split from the signs, then re-attached.

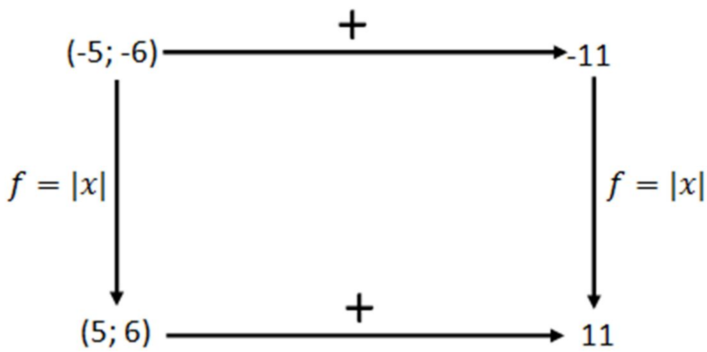


**Figure 5.13 A morphism mapping $(\mathbb{Z}, +)$ to $(\mathbb{N}, +)$**

### 5.4.4.3 Adding a positive and negative integer

Mrs N did four examples during the course of the two lessons, where the arguments were one positive and one negative integer.

For her first example, in L1EE4.2, Mrs N continued her metaphor for borrowing money where R2 was paid to a debt of R6. She required the learners to tell her how much money was still owed using the problem: $+6 + -2 = +4$. She generated a procedure for adding a positive and negative integer using the following steps:

Step one: Determine the smaller and larger number between $+6$ and $-2$.

Step two: Position the symbol of the larger number as part of the solution as shown in Figure 5.14:

**Figure 5.14 A positive symbol is written in the solution**

Step three: Subtract the smaller "whole number" from the larger one: $6 - 2 = 4$.

Step four: The symbol of the larger "whole number" is joined to the difference calculated between the two whole numbers to produce the solution $+4$ as shown in Figure 5.15:


**Figure 5.15 The solution is a positive integer**

Figure 5.16 shows the domain shifts inherent in the teacher's procedure.

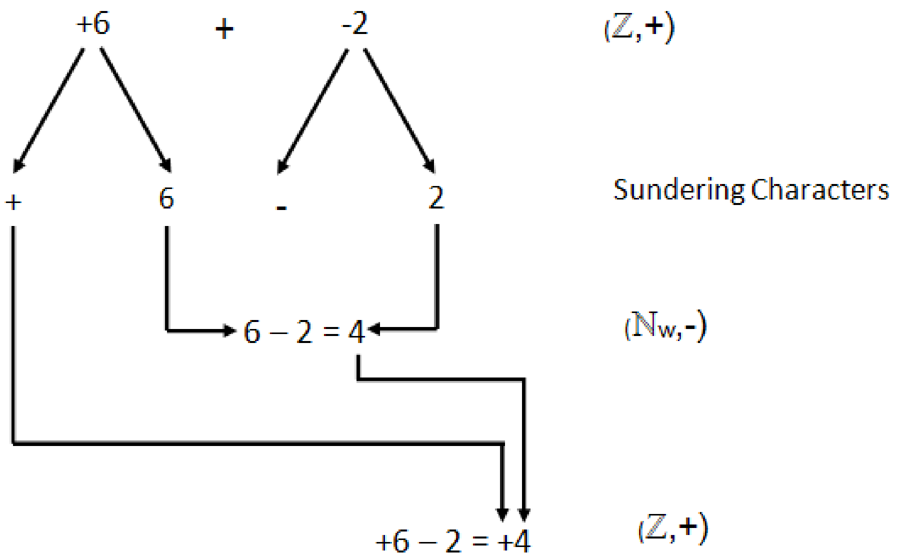


**Figure 5.16 A description of teachers' procedure for adding a positive and negative integer (+6 and -2)**

In order to determine the "big" number in *step one*, Mrs N required the learners to detach the signs from the numerals. For this example, her criterion that all positive numbers were "big" was able to work in *step one* as +6 was greater than -2. For *step two*, the symbol and the numeral were split apart, using the operation-like manipulation of sundering. In *step three*, the integers were converted into whole numbers and the smaller whole number was subtracted from the larger one. In *step four*, the symbol and numeral were glued together or concatenated to produce the solution. The solution was produced through a procedure consisting of a series of steps or rules which primarily focused on the spatial distribution of numerals and symbols. Mathematical reasoning around the addition of a positive and negative integer remained implicit. The objects were manipulated in ways not referenced by the mathematics encyclopaedia.

The teacher's procedure shows that the addition of integers is transformed into subtraction of whole numbers. The procedure starts with integers, shifts to whole numbers before returning to integers. The shift in domains entails treating the integers as characters which allows the splitting of signs and numerals. The shifting of domains from integers to whole numbers can be achieved by a morphism, discussed below, that exploits the absolute value function. It should be noted that the teacher is not employing such a morphism.

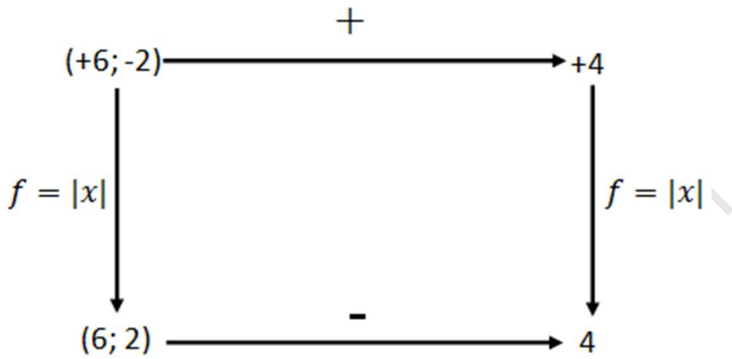


**Figure 5.17 A morphism mapping $(\mathbb{Z}, +)$ to $(\mathbb{N}, -)$: Example 1**

As Figure 5.17 shows, the absolute value function enables a correspondence between the operation of addition performed over the integers to subtraction performed over the natural or whole numbers. The morphism shows a shift in the domain of integers to that of whole numbers. The teacher however achieves the domain shift by treating integers as characters which can be split into signs and numerals.

In L1EE4.4, Mrs N needed to restate her criterion for determining the greater number for *step one* as -8 is less than +4. Her procedure required that -8 and +4 be considered as whole numbers, i.e. as 8 and 4 where 8 was indicated as being the greater number. She proceeded with her procedure as described in L1EE4.2. The analysis of this example as well as other examples is described in Appendix L.1. See Appendix L.2 and L.3 for a description of the teacher's use of metaphors and the teacher and learner interaction, respectively.

### 5.5 Time usage during the lessons

During the lessons on integers, an evaluative event usually commenced with the teacher announcing a new example to be worked on or by calling on learners to complete homework examples on the board. Figure 5.18 shows that three quarters of the total teaching time was spent on either expositing through worked examples or reviewing worked examples. On average, Mrs N spent 4.5 minutes per worked example. The least amount of time (6%) was spent on expositing on mathematical principles and definitions, less time than was spent on marking books and learners copying their homework.

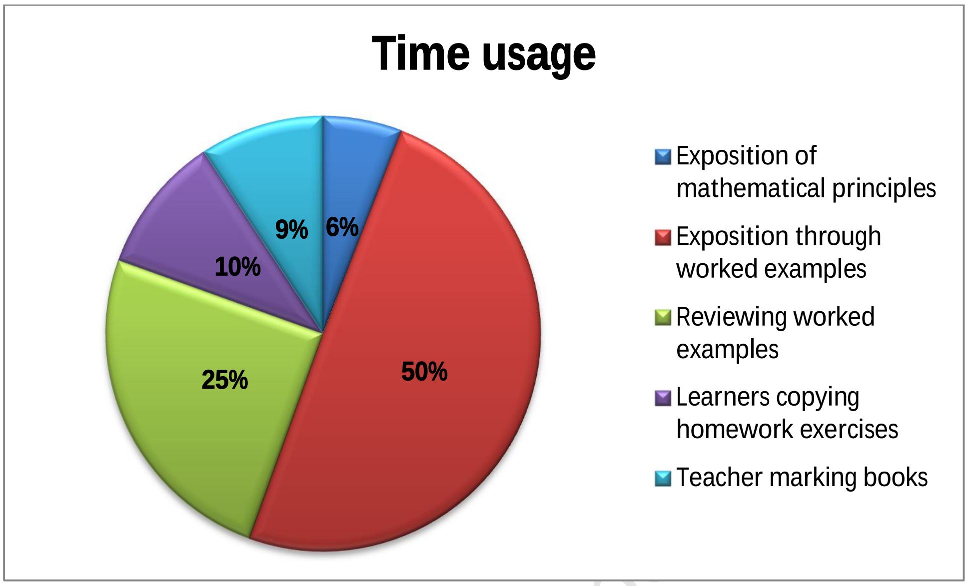


**Figure 5.18 The use of time during lessons on *integers***

**Table 5.3 Time spent on worked examples (*integers*)**

| Integers | Total time on worked examples | Total no of worked examples | Average time per worked example |
|---|---|---|---|
| Lesson One | 01:04:01 | 11 | 6 minutes |
| Lesson Two | 00:32:12 | 10 | 3 minutes |
| Total | 01:36:13 | 21 | 4.5 minutes |



The results presented in Figure 5.18 and Table 5.3 suggest that this teacher primarily used worked examples to exposit on mathematical principles and procedures. There were no instances of learners doing work on integers independently of the teacher.

## 5.6 Summary

The topic of integers was not part of the mathematics curriculum for grade four learners. The set of integers ($\mathbb{Z}$) were defined as consisting of two subsets of numbers, $\mathbb{Z}^+$ and $\mathbb{Z}^-$ and thus excluded zero from the set of integers. Numbers were either "big" or "small" depending on their spatial position in terms of zero on the number line. Integers were ordered in terms of whether they consisted of a positive or negative sign. Integers were added according to a procedure, based on the sign accompanying the numeral. The procedures indicated that the teacher treated integers as characters, consisting of bits such as a numeral and a sign. The bits could be split up and later added to effect the production of a standard solution. The operations used were considered as operation-like manipulations because they are not familiar operations in the field of mathematics. The exposited procedures focused on the iconic features of the mathematical objects. The iconic features were arranged in a specified manner to produce a standard solution to problems. The procedure has been described as a character distribution matrix. When adding integers, the teacher's exposited procedure showed a shift in the domain from integers to that of whole numbers, then back to integers. The addition of two negative integers was transformed into addition of whole numbers and the addition of a positive and negative integer was transformed into the subtraction of whole numbers. The idea of whole numbers was dominant for both the teacher and learners. Most of the lesson time was spent doing worked examples. The learners were not engaged in any independent work, so the teacher was not able to determine whether individual learners had acquired the criteria. Half of the lesson time was spent on worked examples.

# Chapter 6: Data Production for a Grade Six Lesson on *Fractions*

This chapter provides the data production and analyses for a lesson presented to a group of grade six learners on the topic of *fractions*. The lesson was presented by a male teacher, Mr L to a class consisting of six learners. As explained in Chapter 4, the analyses will present the objects made available to the learners as well as the operations employed over the objects. Mr L used representations of objects to produce and add fractions. Where relevant, the representations will be explained using the structure of a morphism, which was described in Chapter 3 (section 3.3.4). Chapter 4 (section 4.2.1.4) explained the application of the concept of the morphism in pedagogic contexts. By describing the objects and operations presented during the lesson on fractions, the pedagogic practice can be illustrated. In so doing, the research questions of *what* gets constituted as fractions and *how* can be answered.

**6.1 Overview of the lesson**

The RNCS assessment standards indicate that grade six learners should be taught the "addition and subtraction of common fractions with denominators which are multiples of each other and whole numbers with common fractions (mixed numbers)" (DOE, 2002b). The teacher's analysed lesson focused on generating fractions and adding common fractions. He only did one subtraction problem.

Based on the content presented during the lesson, the lesson was divided into evaluative events and sub-events. Table 6.1 provides a description of the content and duration of each evaluative event and sub-event. The duration of the complete lesson was one hour, twenty nine minutes and forty five seconds. Each event was described in terms of the pedagogic activity that occurred within the event.

The description in Table 6.1 indicates that the lesson was divided into six evaluative events. The lesson commenced with diagrammatic representations of objects such as bread and cake, which were segmented into parts. Fractions were generated by counting shaded parts and total number of parts. In subsequent events, geometric shapes such as rectangles were used to generate fractions using shading and counting. These fractions were then added to show the addition of fractions with a common denominator. One example was a subtraction problem that occurred during the third evaluative event. During the fifth evaluative event, the learners worked in pairs. They were required to reproduce the teacher's procedure for firstly generating fractions, then adding these fractions. The lesson concluded with the teacher using a diagrammatic representation of an object, a circle, to represent fractions.

**Table 6.1: A description of the evaluative events in the lesson on fractions**

| Evaluative Event | Content | Description | Duration | Time |
|---|---|---|---|---|
| **1.** | Representing Fractions | Expository | 00:16:20 | 00:00:00-00:16:20 |
| **1.1** | Dividing a loaf of bread into parts | Expository | 00:10:03 | 00:00:00-00:10:03 |
| **1.2** | A loaf of bread $\frac{8}{16}$ | Expository | 00:03:21 | 00:10:03-00:13:24 |
| **1.3** | Cake: $\frac{3}{8}$ | Expository | 00:02:56 | 00:13:24-00:16:20 |
| **2.** | Adding two fractions with a common denominator | Expository | 00:08:25 | 00:16:20-00:24:45 |
| **2.1** | Example one: $\frac{3}{8}+\frac{5}{8}=\frac{8}{8}$ | Expository | 00:02:44 | 00:16:20-00:19:04 |
| **2.2** | Example two: $\frac{2}{6}+\frac{2}{6}=\frac{4}{6}$ | Expository | 00:05:41 | 00:19:04-00:24:45 |
| **3.** | Subtraction of fractions with a common denominator: $\frac{4}{6}-\frac{2}{6}=\frac{2}{6}$ | Expository | 00:02:50 | 00:24:45-00:27:35 |
| **4.** | Counting colours in a form board | Expository | 00:02:43 | 00:27:35-00:30:18 |
| **5.** | Adding fractions with a common denominator | Expository and Exercises | 00:53:43 | 00:30:18-01:24:01 |
| **5.1** | Example One: $\frac{3}{8}+\frac{2}{8}=\frac{5}{8}$ | Exercise | 00:29:45 | 00:30:18-01:00:04 |
| **5.1.1** | Example Two: $\frac{2}{6}+\frac{2}{6}=\frac{4}{6}$ | Expository | 00:02:45 | 00:50:13-00:52:58 |
| **5.2** | Example Three: $\frac{3}{8}+\frac{1}{8}=\frac{4}{8}$ | Expository | 00:06:31 | 01:00:04-01:06:35 |
| **5.3** | Example Four: $\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=\frac{5}{8}$ | Exercise | 00:06:51 | 01:06:35-01:13:26 |
| **5.4** | Example Five: $\frac{3}{8}+\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=\frac{8}{8}$ | Exercise | 00:10:35 | 01:13:26-01:24:01 |
| **6.** | Representing fractions | Expository | 00:05:44 | 01:24:01-01:29:45 |

### 6.2 A note on the signing used by the teacher

During the lesson, the teacher used incorrect signs for particular concepts. The signs he used shared some features with the correct signs, which is why some learners were able to understand him. For example, the teacher used an incorrect sign for "respect" and was shown the correct sign by a learner. He signed "Do you see?" in a manner which could be understood as the sign for the numeral *two*.

At one stage, a learner indicated that he did not understand the teacher's signing. The teacher ignored him and continued the lesson. The learner responded as follows:

> 1247. Ly[8]: The problem is you. You keep waving your hands. You must sign better.

Similar to Mrs N, who presented lessons to the grade four and five learners, Mr L used the sign for *who* instead of *what* when he referred to objects. For example, "*Who* is the half of twenty two?"

Mathematical terms relevant to the topic, such as *numerator*, *denominator* and *fraction* were absent in Mr L's signing and speech. He may not have known the signs for those terms. Mr L appeared to be more familiar with signs used in everyday language such as colours and objects such as bread and cake.



### 6.3 The announcement of the topic

Mr L did not announce the topic at the beginning of the lesson. The learners were not aware of the intended topic until the end of the lesson (evaluative event six) during which Mr L asked them what they thought the topic of the lesson was. Two learners responded as follows:

> 1527. Ln: Dividing into parts.
>
> 1529. Ll: Altogether how many colours are there? How many?

The first learner's response indicated that her conceptualisation of the topic was about segmenting an object into parts. The second learner has understood the topic as being about objects in colours which needed to be counted. Mr L wrote the title of the topic "Addition of Fraction" on the board. This title seemed to be the main topic of his lesson, part of which was

[8] The letters *Ln, Ls, Ll, Lp, Ly* and *Lv* refer to the signing of individual learners

the representation of fractions as derived from collections of objects such as slices of bread and wedges of cake. The topic name was made explicit in the teacher's writing but not in his signing.

### 6.4 Production of data and analysis

The data for the lesson was obtained by examining each evaluative event and sub-event, which is detailed in the following section. Transcripts from the lesson were used to provide evidence of the criteria produced by the teacher and learners. From the criteria, the operational activity of the teacher and learners was described. The emerging objects as well as the operations and functions employed over them were determined and will be explained using morphisms where relevant.

#### 6.4.1 Representations of fractions

The purpose of the first evaluative event was to represent fractions using fractional notation. In order to achieve this objective, Mr L's resources were representations of objects such as "bread" and "cake". The objects were portioned into segments as the first step in his procedure for generating a fraction. He called upon learners to represent the objects on the chalkboard. Figure 6.1 shows the "bread" drawn by a learner.



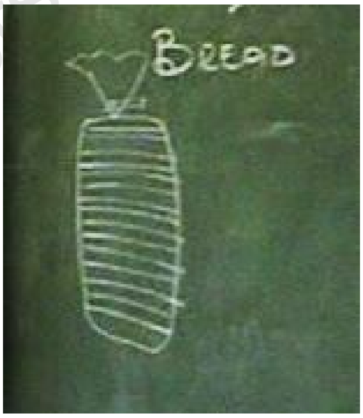


**Figure 6.1 A loaf of bread drawn by a learner**

##### 6.4.1.1 Example using "bread"

During the first sub-event, Mr L pointed at the loaf of bread drawn on the chalkboard (See Figure 6.1) and asked the learners, "How many?" His question seemed to refer to the number of slices in the loaf drawn on the board. After the learners guessed at the number of slices, it appeared that Mr L was referring to an imagined loaf of bread which consisted of 22 slices. He then referred to a "small loaf" as shown in the transcript below:

118. T[9]: What do you say when it's a small loaf?
119. Ls: A small loaf? Eleven, eleven[10].
120. Ll: Ten
121. T: A small loaf?
122. Ln, Ls: Eleven
123. Ll: Ten
124. T: Eleven, eleven, eleven.
130. T: (Writes 11 on the board) eleven, eleven, eleven.
131. Ln: It's twelve (to Ls).
132. Ls: It's ten.
133. T: (Erases 11). Who is the half of twenty two?
137. Ln: Half is twenty one.
138. Ll: There are twenty in a loaf, twenty in a loaf.
139. Ln: A loaf of bread is one, two.
140. Ls: Twenty, twenty, twenty.
141. Lv: Ten.
142. Ll: Twenty two, twenty two.
143. Lp: Ten and ten, and two… Eleven. Listen, it's eleven, eleven.
144. T: It's eleven, eleven, eleven. (Writes '11' on the board).



Initially, it was not clear what the object was when Mr L referred to a "small loaf". By indicating that a "small loaf" contained eleven slices, it was implicit that Mr L was referring to half of the imagined loaf of bread. Mr's L's objective here was to produce a fraction of the form $\frac{a}{b}$, where $a$ represented the numerator and $b$ represented the denominator. By using the term "half", it appeared that his intention was to produce the fraction $\frac{1}{2}$. To achieve this end, it seemed that he conveniently chose to divide an even number, 22 by 2. Mr L constructed a model involving a loaf of bread to introduce the learners to the notion of a fraction. For his conceptual construction of the model, the input value of 22, the operation of $\div 2$ and the

[9] "T" refers to the signing of the teacher.
[10] The transcript is a translation of the teacher and learners' signing into English. The teacher and learners often repeat signs. The repetitions of the signs have been directly translated into English.

output of 11 constitute the represented system for signifying the representing system. The "loaf" and "small loaf", as well as an operation termed "relative complement by 1-1 matching" constitute the representing system. These systems can be described using the structure of a morphism, shown in the external diagram in Figure 6.2.

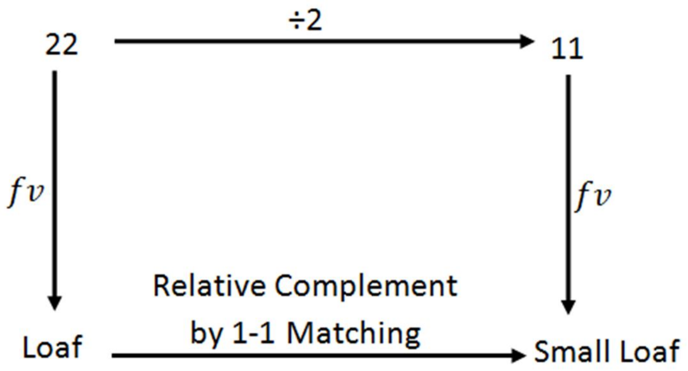


**Figure 6.2 A morphism mapping loaves of bread and numerical values**

To map the represented system to the representing system, a function termed $f_v$ has been applied to the numerical values of 22 and 11. This function is based on John von Neumann's definition of a natural number (Stewart & Tall, 1977) where the natural number $n$ is defined as a set comprised of $n$ elements. The suffix $v$ of the function $f_v$ stands for von Neumann. The function $f_v$ maps the cardinal value of 22 to a class of sets consisting of an infinite number of sets containing 22 elements. Mr L, to achieve his purpose of producing a fraction, pragmatically selected a loaf of bread as a set consisting of 22 elements. The function is mapped as $f_v\colon \mathbb{N} \rightarrow S_F$ where $S_F$ represents the class of finite sets. The mathematical operation performed on the cardinal value 22 to produce 11 was either division by two or multiplication by half. Mr L's use of the term "half" indicates that he was probably conceptualising the operation of division by two. The mathematical operation corresponds to the physical operation termed "relative complement" which is a 1-1 matching between two sets of objects. The physical operation of "relative complement by 1-1 matching" is performed on the "loaf", consisting of 22 slices which is taken and divided into two piles which are more or less evenly matched in terms of height. A slice may be taken from one pile and stacked on the other so that the two "halves" are more or less equal in terms of the number of slices they contain. In cases of odd parity, the "halving" doesn't work too well as the one "half" may have one slice more than the other "half. The operation of "relative complement by 1-1 matching" can be applied in a reasonably stable way in situations where descriptions of discrete quantity are used, such as a sliced loaf of bread. In situations where an object is continuous, such as an unsliced loaf of bread, the distinction between the continuous and discrete is sometimes lost. In other words, “halving” a loaf of bread is not the same as “halving” a sliced loaf of bread. The distinction between continuous and discrete objects is not maintained in Mr L’s pedagogy.

The operation of constructing mathematical complements by using 1-1 matching is explained mathematically as:
Let L be a finite set and $n(\mathrm{L}) = 22$. $L = \{s_1, s_2, \ldots, s_{22}\}$ where L represents the loaf of bread and $s_1$ to $s_{22}$ represents the slices of bread. Form the sets $L_A$ and $L_B$, subsets of L such that $L_A \cap L_B = \emptyset$ and $L_A \cup L_B = L$. Form ordered pairs, starting with the elements of L having the lowest and highest indexes in that order, and then forming a new set. Continue until the empty set is obtained. $L_A$ can be taken to be the subset of L consisting of the first elements of the ordered pairs and $L_B$ the set consisting of the second. The operation of matching to produce ordered pairs can work only in instances where L is of even parity.

In contrast to Mr L’s conceptualisation of the model, he presented the inverse model to the learners as shown in Figure 6.3.



$$\begin{tikzcd}
\text{Loaf} \arrow[r, "\substack{\text{Relative Complement}\\ \text{by 1-1 Matching}}"] \arrow[d, "\text{Counting Slices}"'] & \text{Small Loaf} \arrow[d, "\text{Counting Slices}"] \\
22 \arrow[r, "\div 2"] & 11
\end{tikzcd}$$

**Figure 6.3 The mapping presented by the teacher**

The function performed on the “loaf” and “small” loaf to produce the numerical values is counting. The counting function performed over the two sets, produces 22 and 11 through the operation of division by two. Mr L’s model of the problem can be constructed as a morphism because of the function “relative complement by 1-1 matching” which preserves the structure of the morphism and produces the same outcome as the mathematical operation, division by two, performed on the natural numbers. The function, “relative complement by 1-1 matching” was implicit in Mr L’s explanation as he did not specify how the “small loaf” was derived from the “loaf”. He was reliant on the learners’ prior knowledge of a “small loaf” as being more or less half of a “loaf”. The model more explicitly available to the learners is shown in Figure 6.4 where the function “relative complement by matching” is absent.

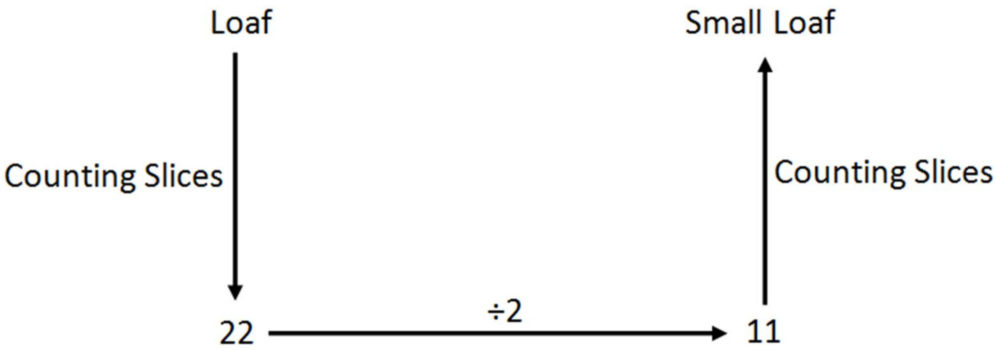


**Figure 6.4 A mapping showing what is explicitly presented to learners**

The criteria generated by Mr L did not specify appropriately what the operations were. Rather, he used the “small loaf” to form a collection or set consisting of 11 objects. His mapping of the “small loaf” to 11 can be explained based on von Neumann’s definition of a natural number. The mathematical operations of multiplication by half and division by two were implicit in his criteria. This sub-event concluded with the learners’ responses indicating that most of them were either not familiar with the concept of “half” or they were unable to do the arithmetic of dividing 22 by two. One learner was able to produce the solution. Mr L then proceeded to the next example.

During sub-event 1.2, Mr L referred the learners to the loaf of bread drawn on the board (See Figure 6.1) which contained 16 slices. The following extract follows when they have counted the total number of slices in the loaf, which were sixteen. Mr L then wanted to know what the half of sixteen was:

163. T: Sixteen, sixteen. So, half of that is what?
164. Ln: The half is…fifteen, fifteen.
165. Ll: Ten, ten, no, nine, nine.
166. Lp: Thirteen, thirteen. Must you divide it?
167. T: Thirteen? What is the half of sixteen?

168. Ll: Nine, nine, nine.

169. Ls: Twenty, twenty.

170. Lp: Sixteen…? Twelve.

171. Ll: Eight, eight.

172. Ln: The half is fourteen.

Because only one learner (Ll) provided the desired response of eight, Mr L shaded the bottom section of the bread (See Figure 6.5). He used the shading as a resource to demarcate the number of parts to be counted to represent half the loaf as well as to graphically show the proportion of the shaded section to the whole object. Criteria explaining proportion and part-whole relation were absent from his exposition. In Figure 6.5, Mr L's use of the equality sign was ambiguous as it was not clear whether the fraction $\frac{8}{16}$ represented the whole loaf, a slice of bread or the shaded area of the bread.

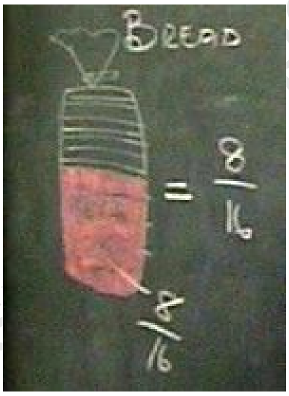


**Figure 6.5 Fractional representation using a loaf of bread**



The following transcript shows Mr L's criteria for generating the fraction $\frac{8}{16}$ and occurred after he had shaded the bottom section of the bread:

214. T: Altogether there are sixteen [*Referring to slices in the loaf*]. Ok. How many are coloured in?

215. Ln: Seventeen [*This learner may not have understood the question*].

216. Ll, Lp: Eight.

217. T: Eight (Points at shaded area. Writes $\frac{8}{}$). How many are there altogether?

218. Lv, Lp, Ll: Sixteen.

219. T: Sixteen.

220. Lp, Lv: Yes.

221. T: (Writes 16 below 8).

The transcript shows that Mr L presented a procedure for generating a fraction which consisted of the following steps.

Step 1: Segment an object into parts

Step 2: Use shading to demarcate parts to be counted

Step 3: Determine the cardinality of shaded parts: 8

Step 4: Write the natural number as the numerator in the template: $\frac{8}{\ }$

Step 5: Count the total number of parts: 16

Step 6: Write the natural number as the denominator: $\frac{8}{16}$

Mr L's procedure for generating a fraction is explained as a character distribution matrix as, described by Johnson and Davis (2010). Character distribution matrices have been previously described in Chapters 4 and 5. In accordance with the description of Johnson and Davis (2010), Mr L used a specific procedure for organising the natural numbers in the form of fractional notation. The rules for the procedure were that shaded parts were counted first and the cardinality written as the numerator. Secondly, the total number of parts in the object were counted and written as the denominator. The fraction generated was not presented as a mathematical object as referenced by the mathematics encyclopaedia, but rather the numbers were presented as characters which were configured in a specific template, $\frac{a}{b}$, using the specified procedure. Johnson and Davis (2010) describe the use of templates for the purpose of character distribution as a regulative resource where symbols or characters are spatially arranged in the form of a procedure to regulate the production of solutions to problems. Mathematical reasoning around fractions as a part-whole comparison was implicit, while a procedure for the spatial distribution of characters was dominant.

Mr L's model of a fraction is an example of a morphism which can be described using the external diagram shown in Figure 6.6. The example presented to the learners was one where the comparison between the "loaf" and the shaded section through the operation of part-whole comparison was the representing system. The numerical values, derived from the function of counting, produced the fraction using an operation termed "spatial distribution", notated as $d_s$, as explained in Chapter 4 (section 4.2.1.4). The input of 8 and 16, the operation $d_s$ and the output $\frac{8}{16}$ were the represented system.

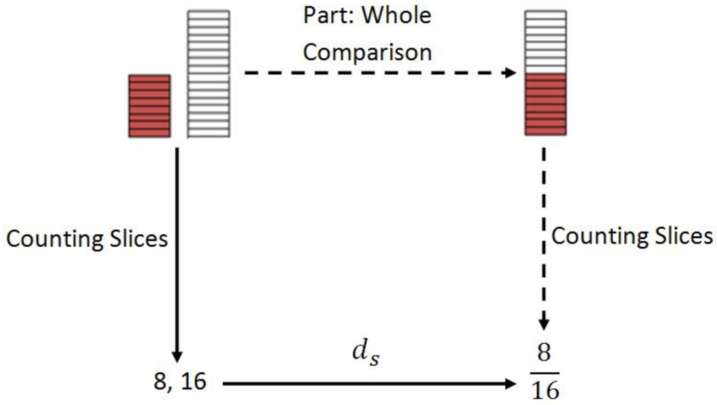


**Figure 6.6 A morphism mapping slices of bread to a fraction**

Figure 6.6 shows that Mr L's input has two arguments, a set consisting of a small collection and another set consisting of a bigger collection. By shading half the number of slices in the loaf, Mr L produced a graphical representation of proportion where the number of shaded parts could be compared to the number of slices in the whole loaf of bread. Shading marked out the two different sets for comparison of the part to the whole. For Mr L, the comparison between the parts and whole is linked to the idea of a fraction, which in this case seemed to be $\frac{1}{2}$. The comparison between the shaded parts and the loaf was explicitly shown in Mr L's graphical representation of the loaf. In Mr L's pedagogy, the notion of a continuous loaf of bread is conflated with that of a loaf consisting of discrete slices. When portioning the bread, Mr L did not include important aspects such as volume in his exposition in order to produce a mathematically precise example. Criteria regarding the part-whole relationship represented by the fraction $\frac{8}{16}$ were absent, as shown by the path marked by the broken arrows. Mr L's criteria more explicitly show the path down then across where shaded parts and total parts were counted and spatially organised in the form of a template using the procedure described in evaluative event 1.2. The operation, referred to as "$d_s$" (spatial distribution), is not a mathematical operation referenced in the mathematics encyclopaedia. However, it has been defined as an operation-like manipulation due to the stable manner in which Mr L has set up and applied the rules for producing a fraction, where the number of shaded parts was written as the numerator and the total number of parts was written as the denominator.

The analysis of sub-event 1.3 is described in Appendix M.1, where Mr L repeated his procedure for generating a fraction using an example of “cake”.

In summary, the first evaluative event was concerned with representing fractions using objects such as “bread” and “cake”. The teacher produced a procedure for generating a fraction using shading to demarcate parts to be counted and to graphically represent the relationship between the parts and the whole. The shading differentiated between two sets produced by the teacher. The elements in each set were counted. The cardinality of the parts was arranged in a specific form $\frac{a}{b}$, where shaded parts were represented by the numerator $a$ and total parts were represented by the denominator $b$. The conceptualisation of a fraction was described in terms of a character distribution matrix rather than as a mathematical object as recognised in the field of production. When portioning objects, the teacher slipped between the continuous and discrete. Important aspects in terms of part: whole relationships such as volume were absent from the teacher’s criteria. For further examples of fractional representation, see Appendix M.2.3.



**6.4.2 Addition of fractions**

The topic of the second evaluative event was the addition of fractions with a common denominator. Mr L presented two examples. In both examples, he re-exposited his procedure for producing a fraction. The fractions were then added. For the first example, Mr L used the fraction $\frac{3}{8}$ generated in sub-event 1.3 and wrote the operation of addition next to the fraction. He then generated the fraction $\frac{5}{8}$ using the procedure described in evaluative event 1.2. The model is described in terms of a morphism shown in Figure 6.7.

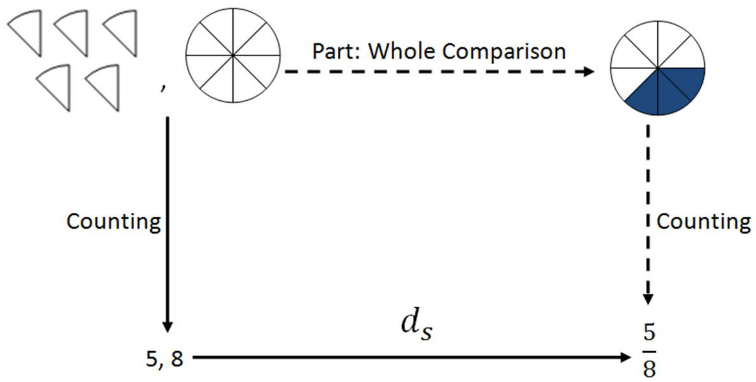


**Figure 6.7 A morphism mapping unshaded segments of “cake” to a fraction**

The inputs were the two sets consisting of five and eight elements respectively. The first set was marked out as being unshaded. The second set, the total number of parts. The fraction $\frac{5}{8}$ was produced through counting the elements in the sets and arranging the natural numbers in a template $\frac{a}{b}$. Using the operation of spatial distribution, the unshaded parts were written as the numerator, 5. The total number of parts was written as the denominator, 8, as shown in Figure 6.8.

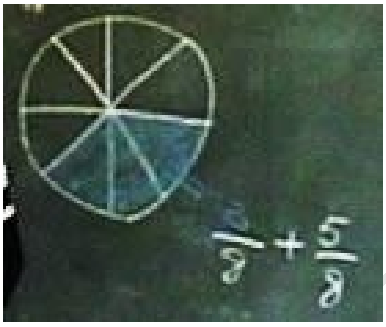


**Figure 6.8 Adding the two fractions generated**



When adding fractions with a common denominator, Mr L generated criteria as shown in the following extract from the transcript:

340. T: I'll say it again. When these (points at denominators of both fractions) are the same, take one and put it here (points at denominator of the solution). Do you understand?

341. Lp: I understand.

Figure 6.9 shows the spatial arrangement of the denominator:

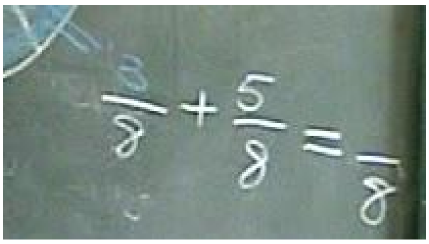


**Figure 6.9 The denominator is written in the solution**

342. T: (Points at numerators). Take these (3 and 5) and put them here (Points at 3+5).

Figure 6.10 shows the teacher's spatial arrangement of the numerators:

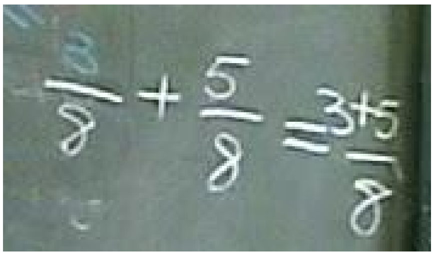

**Figure 6.10 The numerators are arranged above the denominator**

342. T: Add three and five. (Points at 3+5). Who is it?

343. Lp: Eight

344. T: (Writes = $\frac{8}{8}$). Do you understand?

Figure 6.11 shows the solution of $\frac{8}{8}$.

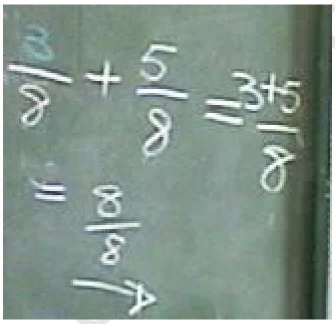

**Figure 6.11 The solution is presented as a fraction**

Mr L’s criteria for adding fractions are diagrammatically represented in Figure 6.12.

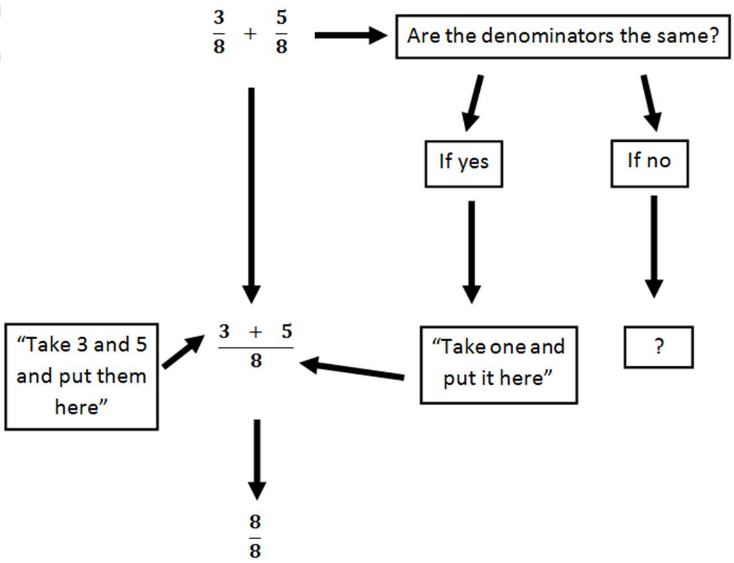


**Figure 6.12 Procedure for the addition of fractions with a common denominator**

The first step was to determine whether the denominators were the same. If they were, Mr L produced a procedure for adding fractions using a character distribution matrix where fractions were treated as characters which were re-organised into a specific template. The criterion was to "take one" denominator, referring to 8, and to "put it here" where he referred to the denominator in the next step. The numerators were added as whole numbers to produce the fraction $\frac{8}{8}$. Mr L did not exposit on what to do if the denominators were not the same, as all his examples contained fractions with common denominators. Because Mr L had not explained the fractions $\frac{3}{8}$ and $\frac{5}{8}$ in terms of proportion, the solution of $\frac{8}{8}$ was not referenced as the whole object which was equivalent to 1. Mr L's mapping construction of the model can be diagrammatically represented by the morphism shown in Figure 6.13.

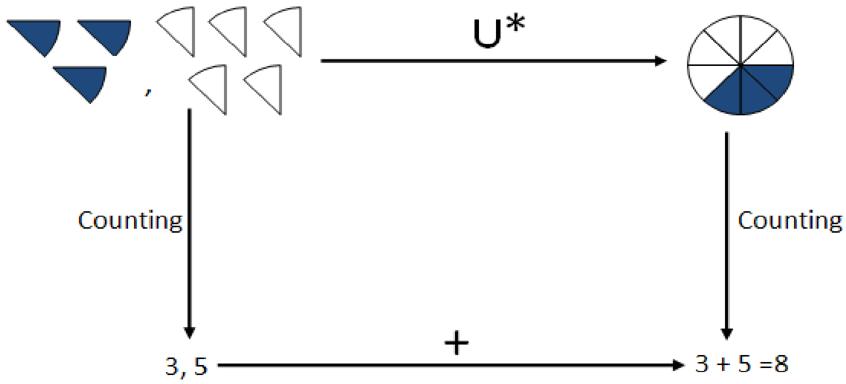


**Figure 6.13 A morphism mapping segments of cake to natural numbers**

Figure 6.13 shows Mr L's mapping of fractions to whole numbers using the function of counting. The inputs were two sets consisting of 3 and 5 elements which were distinguished by shading. The top row shows that the operation disjoint union ($\cup^*$) was performed on the two sets to produce a graphical representation of the two proportions, where the elements are eighths, but are treated as units by the teacher. Disjoint union is a binary operation that "…combines all distinct elements of a pair of given sets, while retaining the original set membership as a distinguishing characteristic of the union set" (Weisstein, 2007). The operation of disjoint union corresponds to addition. The elements were then counted and added as natural numbers. The second method indicated by the path down then across showed that the elements were first counted then added as natural numbers rather than as fractions. The example of shaded segments of "cake", the operation of disjoint union as well as the graphical representation of proportion was the representing system to characterise the represented system which was the addition of natural numbers.

For the second example in the second evaluative event, Mr L drew a rectangle on the chalkboard which he segmented into six parts. Two learners were called up to shade two parts in blue and two parts in red respectively, as shown in Figure 6.14.

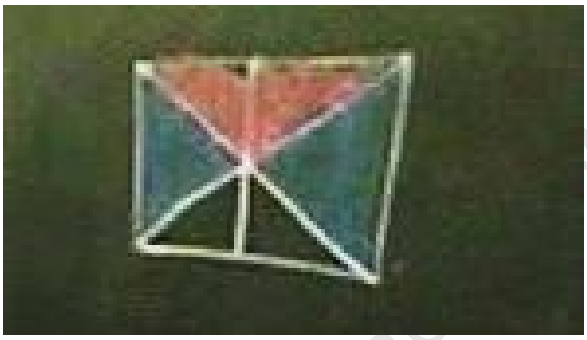

**Figure 6.14 Fractional representation using a rectangle**

Mr L used the rectangle to re-explain his procedure for generating and adding fractions with the same denominator. He started by generating a fraction using the blue segments. His model is represented in Figure 6.15 and is similar in structure to the morphism represented in Figure 6.7. The operation of part: whole comparison performed on the shaded parts and total parts to produce a graphical representation of the proportion was the representing system. The operation of spatial distribution performed over the natural numbers to produce a fraction was the represented system. When portioning the object, Mr L did not take the area of the rectangle into account which was necessary for the example to be mathematically precise. This example again showed his slippage between the continuous and the discrete.

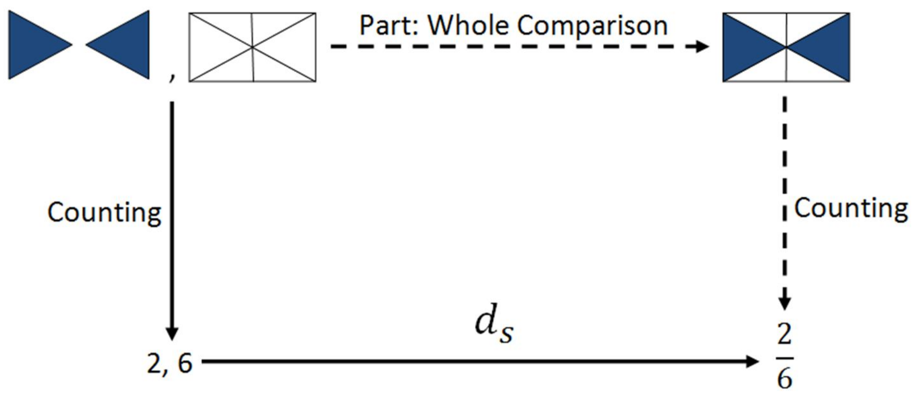


**Figure 6.15 A morphism mapping proportions to natural numbers**

Figure 6.15 shows that the parts were shaded to graphically represent a proportion. Mr L constructed two sets, with two and six elements respectively. The operation part: whole comparison was performed on the two sets to produce an output which is the graphical representation of proportion. The counting function performed on the proportion, produced the output, a fraction $\frac{2}{6}$. The method described is represented by the path across then down and was absent from Mr L's criteria as indicated by the broken arrows. The path down then across describes Mr L's explicit criteria where the elements in the sets were counted. The natural numbers were organised in a template through the operation of spatial distribution ($d_s$). Mr L used the same model to produce a fraction using the parts shaded in red as shown in Figure 6.16.



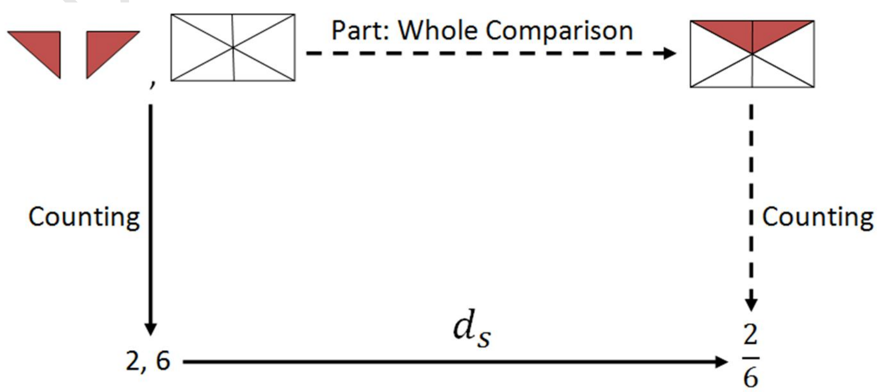


**Figure 6.16 A morphism mapping proportions to natural numbers**

The two fractions generated from the shaded parts of the rectangle were then added, the mapping of which is represented in Figure 6.17.

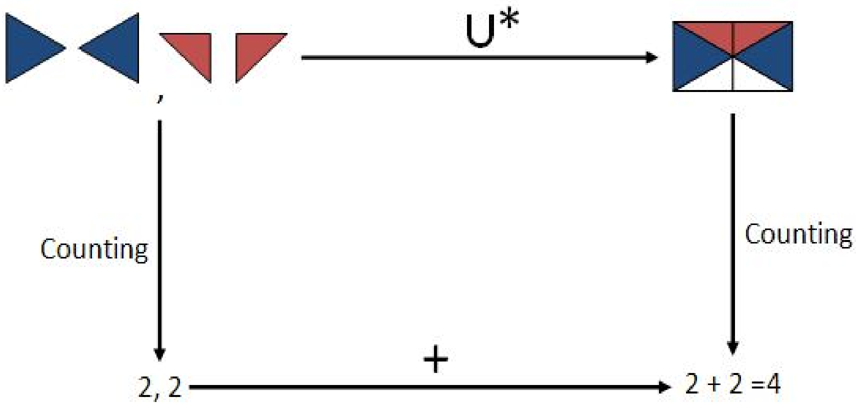


**Figure 6.17 A morphism mapping segments of a rectangle to natural numbers**

The arguments are two sets each consisting of two elements. The operation disjoint union was performed on the elements to produce a graphical representation of the part: whole relationship. The parts were counted to produce the solution: 4. The second path shows that the elements were first counted. The operation of addition was performed on the cardinal values to produce the same output: 4.

Mr L used his previously exposited procedure for generating the fractions using the red and blue shaded segments. For adding the fractions $\frac{2}{6}+\frac{2}{6}$ his procedure was as follows:

Step 1: If the denominators are the same, "take one":6

Step 2: One denominator is written in the allocated space in the template: $\frac{}{6}$

Step 3: Place the numerators and the operation (+) in the allocated space in the template: $\frac{2+2}{6}$

Step 4: Perform the operation on the numerators: 2 + 2

Step 5: The solution is a fraction: $\frac{4}{6}$

Mr L's procedure shows that fractions were added in the form of a character distribution matrix, as described in the example of "cake". The first step was to ascertain whether the denominators were the same. If they were, "one" was taken and written as the denominator in the solution. The other denominator was ignored. The numerators were then added and the solution was presented as a fraction. For more examples on the addition of fractions, see Appendix M.2.

In summary, the second evaluative event dealt with the addition of fractions with a common denominator. The teacher used the procedure for generating fractions which he exposited in the first evaluative event to produce the fractions to be added. He produced a procedure for adding the fractions. His major resource was the use of a template where fractions were treated as characters which were arranged in specific positions in the template. He also relied substantially on counting as a resource. Addition of fractions was therefore conceptualised as counting and addition of whole numbers.

### 6.4.3 Subtraction of fractions

For the third evaluative event, Mr L did a subtraction problem: $\frac{4}{6}$ - $\frac{2}{6}$ = $\frac{2}{6}$. He obtained the $\frac{4}{6}$ from the example described in evaluative event 2.2. He generated the fraction $\frac{2}{6}$ by applying his procedure and counting the number of unshaded parts in the rectangle. The model constructed by Mr L for this example is described in Figure 6.18.

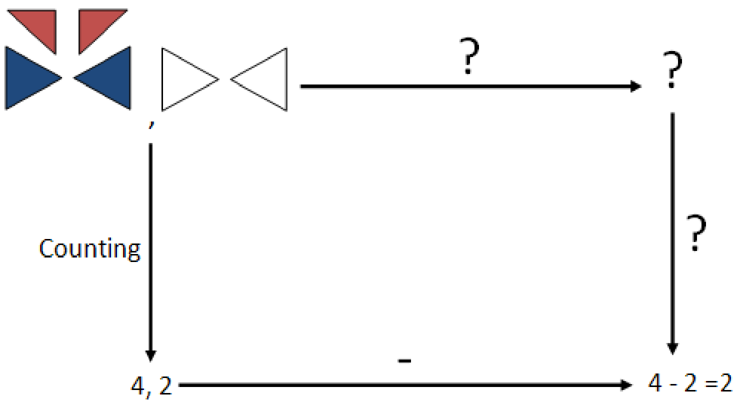


**Figure 6.18 A mapping of shaded segments to the subtraction of natural numbers**

Figure 6.18 shows that similar to his previous examples, Mr L's input was two sets, consisting of four and two elements respectively using shading. He attempted to reproduce the model he used for addition for a subtraction problem. However, the model is unable to work as addition is dependent on disjoint union where two or more sets are needed. For subtraction, the elements making up the input need to belong to the same set. Mr L's subtraction example, using the part: whole model employed for addition was unable to work when the operation was subtraction. As Figure 6.18 shows, there is no corresponding operation and output for the input shown by the path across then down. The example does not preserve the structure of a morphism. Similar to his model for addition, the inputs were counted. The cardinal values were subtracted as natural numbers as shown in the path down then across. When the operation was subtraction, the teacher's model was not able to work, but his procedure was feasible as it was based on arithmetic.

### 6.4.4 Counting colours in a form board

During the fourth evaluative event, Mr L used a form board consisting of shapes in different colours similar to the picture in Figure 6.19.

**Figure 6.19 The form board used as a resource for counting**

He added and removed shapes, expecting the learners to count the number of shapes of specific colours. Initially, he pointed at the empty shapes in the board. It was implicit that he expected the learners to count the number of shapes. They seemed to guess the implicit criteria as the lesson had mainly focused on counting and responded appropriately. Mr L seemed to be doing this activity because counting was an important part feature of his procedure for generating a fraction. He may have been making an association between counting the different colours of the forms and the shading he used when generating a fraction. Mr L seemed to do this activity to emphasise counting of elements, however the activity had no mathematical relevance to the topic of fractions.

### 6.5 Time usage during the lessons

The pedagogic activity occurring during the evaluative events were either expository using worked examples or learners doing exercises in groups. Figure 6.20 shows that the lesson was equally divided between these two pedagogic activities. The teacher did not spend any time on the exposition of mathematical definitions and principles.

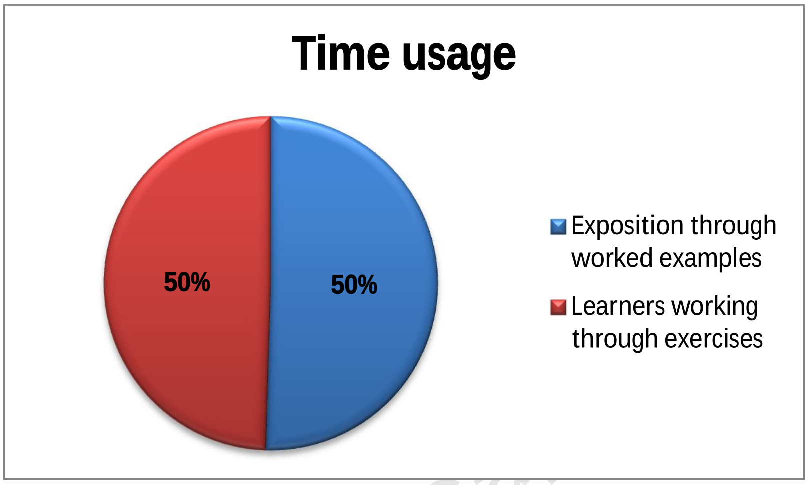


**Figure 6.20 The use of time during a lesson on *fractions***

Figure 6.20 shows that worked examples were used throughout the lesson, either through the teacher's exposition or the learners' exercises. Table 6.2 shows that the average time spent on a worked example was 7.5 minutes. The learners spent half the lesson doing work independently of the teacher. The teacher did not spend any time expositing on mathematical principles and definitions.

**Table 6.2 Time spent on worked examples (*fractions*)**

| | Total time on worked examples | Total no of worked examples | Average time per worked example |
|---|---|---|---|
| Fractions | 1:29:45 | 12 | 7.5 minutes |

### 6.6 Summary

The analysis and production of data showed that fractions were constituted in the form of a template or spatial distribution matrix. The fractions were generated through the function of counting, using a specified procedure where the number of shaded parts were written above the number of total parts in the form $\frac{a}{b}$. The operation performed over the cardinality of total parts and shaded parts was termed "spatial distribution" due to the stable manner in which the operation was performed over the counted parts. Spatial distribution is not a recognised mathematical operation recognised in the field of production.

The generated fractions were added using a specified procedure which also took the form of a character distribution matrix. The characters were organised in a specified arrangement and were not conceptualised as fractions as referenced by the mathematics encyclopaedia. Addition of the fractions was constituted as counting and whole number addition of the numerators.

Morphisms illustrate how the metaphors or models used by the teacher function to represent the mathematical ideas to learners. Morphisms showed that the teacher's presentation of a fraction was explicit in terms of a graphical depiction of proportion, however he did not refer to proportion in his exposition. Fractions were not conceptualised in terms of a comparison between the parts and the whole but rather, were explained in terms of a character distribution matrix. The morphisms were based on the teacher's representations of fractions using models. The extensive use of models or metaphors formed a significant part of the teacher's pedagogy. The models implemented seemed to prioritise shading, counting and spatial distribution rather than the notion of a fraction as a part: whole comparison. These features seemed to further detract the learners from conceptualising a fraction as a part: whole comparison thereby reducing the topic to counting. The learners conceptualised fractions as counting and colours, as evidenced by their responses when asked what they thought the topic was (see section 6.3).

The teacher used worked examples to exposit on fractions. Worked examples were the means by which he produced his procedures for both generating and adding fractions.

The teacher's pedagogy on fractions conflated the distinction between continuous and discrete objects. Continuous objects were divided into segments and fractions were based on counting of segments. It was not indicated that discrete objects could have even or odd parity as only even numbers were exemplified. Important aspects such as area and volume were absent when portioning continuous objects.

# Chapter 7: Conclusions regarding the constitution of mathematics

The study forms part of the general problematic of the constitution of mathematics in pedagogic contexts of schooling. This study investigated the constitution of mathematics in a particular context, that of the classrooms of deaf learners. These learners, in grades 4, 5 and 6, were taught in sign language. The purpose of the study was to answer the research questions of:

1. *What* is constituted as mathematics in the particular pedagogic context?
2. *How* is this constitution realised?

The study was located within the framework of Bernstein's pedagogic device. The theoretical framework drew on the resources of Davis (2009b, 2010a, 2010b, 2010c, 2011a, 2011b, 2011c) as well as the use of morphisms (Baker et al, 1971; Bruckheimer and Sterling, 1968; Davis, 2012; Krause, 1969; Open University, 1970). These resources were used to produce the framework for the analysis and production of data from the video records of observed lessons in grade 4, 5 and 6 classrooms. The teaching and learning of four lessons were observed on the topics of *integers*, *fractions* and *time*. The framework was used to describe the operational activity of the teachers and learners during the lessons recorded, specifically the objects made available by teachers as well as the operations employed over them. In so doing, I was able to describe the *what* and *how* of the constitution of mathematics within the pedagogic context of deaf learners. This chapter summarises my analysis of the observed lessons in relation to the research questions and with reference to my analytic framework. Furthermore, I reflect on the limitations and potential of the study. I return now to the pedagogic device which provided an overall frame for the study.

## 7.1 The pedagogic device revisited

The study was situated at the last tier of the pedagogic device, that of evaluation where the transmission and acquisition of knowledge occurred. At the level of pedagogic practice, the constitution of mathematics was investigated by examining the operational activity of the teachers and learners, specifically the objects and operations that were made available. The following section describes the conclusions drawn regarding the constitution of mathematics within the pedagogic context.

### 7.1.1 The *what* and how of the constitution of mathematics

The data produced from the study indicated that, for this group of deaf learners, integers were treated as whole numbers with signs attached to them. The set of integers ($\mathbb{Z}$) was defined as consisting of the subsets, $\mathbb{Z}^+$ and $\mathbb{Z}^-$, thus excluding zero from the set $\mathbb{Z}$. The manner in which the integers were ordered was dependent on the sign preceding the numeral. Integers were added according to a procedure, based on the sign accompanying the numeral. Integers were thus treated as characters made up of bits, such as the numeral and sign (+ or -), which were split apart and glued back together. The bits could be split up and glued back together using operation-like manipulations in order to effect the production of a standard solution. Thus integer arithmetic was constituted as whole number arithmetic in this pedagogic context.

For these deaf learners, fractions were constituted as counting of parts. Fractions were generated in the form of a template or spatial distribution matrix, using a specified procedure where the number of shaded parts was written above the number of total parts in the form $\frac{a}{b}$. The teacher employed an operation-like manipulation termed "spatial distribution" to effect the procedure for generating a fraction. The addition of fractions was constituted as counting and whole number addition of the numerators.

The data from the study indicated that mathematical concepts were not clearly defined for these learners in terms of the objects that were made available. Mathematical objects were mostly treated as physical objects or characters which were manipulated in ways not referenced by the mathematics encyclopaedia. In addition, the principles regarding mathematical objects that were presented to learners were not drawn from the mathematics encyclopaedia which detracted the learners from conceptualising these objects. The topic of fractions was essentially constituted as counting and integer was constituted as whole number arithmetic.  Mathematical reasoning around these objects was therefore suppressed. The content actually taught to learners displayed very little resemblance to the content usually suggested by the topics of fractions and integers.

A significant feature of the constitution of mathematics in the teachers' pedagogy, was the use of operation-like manipulations performed over the objects. Mathematical objects such as integers for example, were treated as characters or symbols rather than as numbers. Operation-like manipulations such as "sundering" and "concatenation" were used with computations over integers. Another example of an operation-like manipulation was that of "spatial distribution", which was employed to manipulate numbers that were transformed into characters or symbols. "Spatial distribution" is not a mathematical operation recognised in the mathematics encyclopaedia, however this operation-like manipulation was used fairly consistently to produce a standard output, a fraction. This operation-like manipulation was employed in many worked examples of a similar nature and formed part of a procedure that substituted a fraction as a part: whole comparison. It is questionable whether these learners recognised a fraction as a part: whole comparison.

An important feature of the teachers' pedagogic practice was the use of character distribution matrices as a resource for the production of standard solutions to problems. The solutions generated were based on specific procedures, which exploited the spatial arrangement of symbols rather than the symbolic meaning of the mathematical expressions. The use of character distribution matrices has been found to be operable in other pedagogic contexts (Jaffer, 2010; Johnson & Davis, 2010) which seem to favour the iconic features of expressions. The use of character distribution matrices were used to regulate the production of standard solutions to problems for both the addition of integers and fractions.



Another resource employed for recontextualising knowledge was the use of models for the representation of mathematical ideas to learners. The use of morphisms in the analysis of the lessons revealed the teachers' use of models as a substitute for the content to be taught. The teachers also made use of metaphors where they related everyday content to mathematical content. Their examples of metaphors were not appropriate and did not relate mathematical principles to the object of comparison. The use of models and metaphors seemed to further distance the learners from the content to be acquired.

In pedagogic contexts, criteria are generated for the recognition and realisation of mathematical objects, operations and processes. A standard feature of the pedagogic practice of the study was the implicit nature of the criteria, where criteria related to the topic were not unequivocally made available to learners. For example, the use of a fraction to represent a part: whole comparison was implicit in the teacher's exposition. In the lesson on the topic of time, it was implicit that the domain of numbers (from 1-12) on the clock-face, represented the number of minutes past the hour. Criteria were explicit when expositing on the spatial nature of objects, for example emphasis on the specific arrangement of characters within a template; or more familiar aspects of the topics, for example computations over whole numbers rather than integers. The implicit nature of the criteria resulted in the learners not being able to engage with general mathematical principles as referenced by the mathematics encyclopaedia, and seemed to cause ambiguity. Criteria were at times context-dependent. These criteria needed to be re-stated for their application.

Figure 7.1 shows that 65% of the total time was spent on worked examples, either as a vehicle for the teacher's exposition or as an exercise for learners to practice the procedures exposited on. Despite the fact that a considerable amount of time was spent on producing these standard solutions using worked examples, learners continued to have difficulties reproducing the solutions. A possible reason may be that the objects and general principles were not appropriately defined in mathematical terms (Davis & Johnson, 2007) as indexed by the mathematics encyclopaedia.



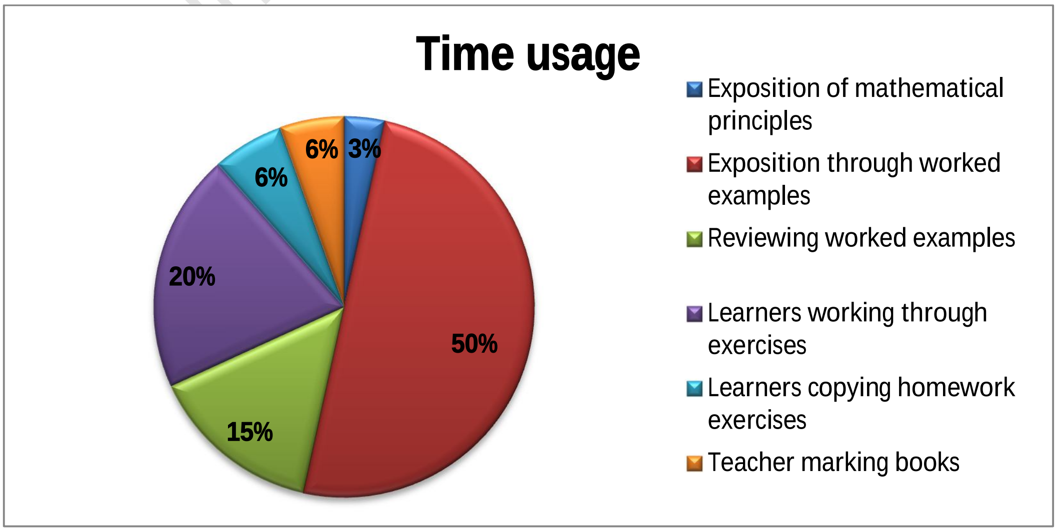


**Figure 7.1 Total time usage in the lessons**

Ambiguity at the level of criteria could, in part, be attributed to the sign language used by the teacher. The teachers often used incorrect and inappropriate signs, which created confusion at the level of the criteria. Mathematical terms relevant to the topic were absent from the teachers' expositions which further seemed to weaken the conceptualising of mathematical objects. Mathematically relevant signs may not be readily available to teachers of the deaf. Consequently, the topic names were not explicitly available to the learners. Contrary to the principles of bilingualism, one teacher simultaneously signed and spoke. Bilingualism favours the use of sign language, which is a policy directive when teaching deaf children.

### 7.1.2 How was mathematical knowledge organised?

The framework of the pedagogic device dictates that what is implemented in pedagogic practice is determined by how knowledge is recontextualised or organised. Because there are no clearly defined recontextualising directives from the Department of Education for deaf learners, teachers have absolute freedom in the way knowledge is recontextualised for these learners. The knowledge that is transmitted and acquired is completely dependent on the resources offered and made available by teachers. Where no clear guidelines are given in terms of recontextualisation, teachers resort to recontextualising knowledge themselves which has repercussions in terms of quality, as shown by the current study. The study showed that they were taught a topic (integers) which was not appropriate at their age-level. The manner in which integers and fractions were constituted was not in line with the curriculum. This misalignment with the curriculum has repercussions in terms of equality, as deaf learners should be taught the same curriculum as normal hearing learners are. Equality in education is a policy directive, however is not achieved at the level of implementation. Rather the current scenario indicated that the disadvantage of these learners was further amplified in their educational setting. The implication is that intense school-level monitoring is required in the form of curriculum advisors. There is also a need for textbooks which have been recontextualised for deaf learners. Teachers of the deaf need to have adequate training in pedagogic methods relevant to deaf learners. They should also have adequate knowledge of the content they are teaching, such as mathematical content. Signs for mathematical terms need to be made accessible to teachers of the deaf.

### 7.1.3 Who gets what?

The policy for the education of the deaf was derived from the Constitution which promotes equality and human rights. The policy directs what *ought* to be in play in pedagogic practice (Davis, 2010c: 1, italics in original). It was a policy directive that deaf learners have equal access to the curriculum. Deaf learners ought to get the same knowledge as hearing learners, however this case study has shown a breakdown between policy intentions and what is distributed at the level of implementation. Deaf children's rights to an equal education were violated as they were not getting what the policy intended. Perhaps it should be a policy directive that teachers of the deaf have adequate training in sign language as well as mathematics prior to working in a school for the deaf if these learners are to have equal access to the curriculum.

## 7.2 Limitations and potential of the study

The teaching and learning of deaf learners is an under-researched area in South Africa. This study, about pedagogy for the deaf, was limited as a case study as the results could not be generalised to pedagogic practice in other schools for the deaf. It would be interesting to compare the current data to data produced at other pedagogic contexts. Further research is needed at other pedagogic sites to make more general statements about what deaf children are being taught in South African classrooms. In so doing, the quality of teaching and learning for these learners can be improved. However, as an under-researched area, this study has potentially inspired further, much-needed research in the pedagogic practices of teachers for the deaf. The study has shown that more investigation is needed within the sphere of education for the deaf, specifically in teachers' mathematical content knowledge and sign language proficiency. Also, interviews with learners to establish what was constituted as mathematics for them, would have enriched the study.

Due to the size of the study, I was not able to explore the teachers' knowledge of mathematical content, which is a vital component in their pedagogic practice as was shown by the current study. An investigation of this kind would have revealed whether the teachers lacked the necessary mathematical knowledge needed for teaching the topics referenced or if their pedagogic practice was more greatly influenced by the fact that they needed to teach in sign language, a language which they had not been formally trained in.

Another limitation of the study was that I was not able to achieve triangulation of the data through teacher interviews as the teachers were not cooperative in this regard. Triangulation may have enhanced the data analysis process as I could have gained more information about the teacher's choice of topic and whether they were knowledgeable about the content of the curriculum. These factors are influential to the constitution of mathematics. It would have also been helpful to gain more information about the difficulties these teachers experience in implementing the curriculum as well as their difficulties with sign language.

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# APPENDICES

## Appendix A: Perspectives on Deafness

According to (Reagan, Penn & Ogilvy, 2006) issues regarding deafness in the literature are usually distinguished by two perspectives: the medical perspective and the 'socio-cultural' perspective. The medical perspective which is the more dominant, views deafness as 'pathological' where a deaf person is said to have a medical condition characterised by an auditory deficit. The deficit thus requires remediation in order to assimilate the deaf person into a hearing society and to make them as hearing as possible. The medical perspective views deaf people as being different and physiologically inferior to hearing people. The effect of this perspective on education was that deaf children were forced to talk at school and were taught to lip-read. Various hearing devices such as hearing aids and cochlear implants were used to maximise residual hearing so that deaf children could become more like hearing children.

The alternative is the socio-cultural view which originates from an anthropological perspective. This perspective views deafness not as a deficit but as a cultural condition where civil rights issues are the main focus. Within this perspective, the deaf are viewed as individuals who are members of other dominated and oppressed cultural groups. Advocates of this perspective focus on civil rights issues and to enable deaf persons to function within a dominant culture (Shapiro 1993 in Reagan et al, 2006).

These two perspectives thus distinguish 'audiological deafness' from 'cultural deafness'. Audiological deafness refers to some form of hearing loss, while cultural deafness refers to membership in the deaf cultural community. Membership in this community involves the use of a natural sign language as the vernacular; culturally appropriate behaviours; endogamous marital patterns; an acceptance of the historical understanding of the cultural community as well as participation in the various voluntary organisations of the community (Reagan, Penn & Ogilvy, 2006).

For Reagan et al (2006), deafness within the South African context provides another perspective which is grounded in a more socioeconomic framework. The reason for this perspective is that for most South African deaf people, the ideologies of the pathological and socio-cultural perspectives are not a reality. For many South Africans there exists a lack of access to the social and economic infrastructures which make these perspectives viable. Lack of this accessibility is attributed to poverty and economic constraints.

The relevance of these perspectives to education is the way that the deaf view themselves. In education, deafness is listed along with other disabilities such as blindness and physical disabilities. However, many deaf people regard themselves not as being disabled, but as being part of a linguistic minority where their language, a signed language, does not receive the same rights as other languages (Aarons & Akach, 1999). According to this view, deafness is not the primary barrier in education, rather access to language is seen as the primary barrier to learning. If this barrier was removed, deaf people would no longer be disabled (Aarons & Akach, 1999) and would gain complete access to the curriculum.

## Appendix B: The Forms of Communication Emerging from the Historical Context of Education for the Deaf

### B.1 The international context

The history of sign language can be traced to 1750 in France where the Abbé Charles-Michel de l'Epée undertook to teach two deaf-mute sisters (Stokoe, 2005). A few years prior, Jacob Rodrigues Pereira had come to France from Portugal and also taught deaf mutes. Their methods of teaching the deaf differed in many respects. Pereira's method was to teach the French language through articulatory exercises, ordinary writing and a set of one-handed manual symbols corresponding to the letters of the alphabet. L'Épée was able to recognise that the minds of the deaf were functioning by means of a language; however he realised that the language used by the deaf was not French. He became the first person to attempt to learn this language, use it and make it a medium of instruction to teach French to his deaf-mute students. He called this language "le langage des signes naturelles" or "the natural language of signs" (Stokoe, 2005). He also devised a system called his "signes méthodiques", now called a meta-language, to teach abstract thought through French grammar. He later realised that this natural language used by his deaf students was necessary in their everyday communication, however needed to be adapted for the purposes of teaching the French language and culture. He invented signs for grammatical constructs, such as articles, which did not exist within the natural sign language. In so doing, he was able to form a link between natural signing and French. Through the use of his "signes méthodiques" he was able to introduce his deaf students to a foreign language such as French in all its formal sophistication. He was also able to converse with his deaf students in their natural language (Stokoe, 2005).

The term "methodical signs" was used as the signs were based on the methodical syntax of French. In L'Épée's school, students attended for four or five years where the main focus was on learning French. His primary aim was for his deaf students to develop literacy skills. Subjects such as history and geography only received attention in the latter part of the student's education (Stedt & Moores, 1990).

In time, L'Épée's first students became the primary teachers in the school and were able to translate written French into natural sign language for their students (Stokoe, 2005). At that time, the use of sign language in teaching was considered to be the most effective way for the deaf to receive an education (Coryell & Holcomb, 1997).

The methods used by L'Épée were seen as a departure from the methods used in private programmes at that time which advocated the use of orals skills as the only option for deaf children to be educated. The pedagogical shift from oral to sign as well as the type of sign used in the education of the deaf continues to receive considerable attention in education today and is still the focus of debate (Coryell & Holcomb, 1997).

In 1789, the Abbé de L'Épée died and was succeeded by the Abbé Sicard who had studied under him. The Abbé Sicard was put in charge of a deaf school which was founded at Bordeaux. He was attributed to having even greater success than his predecessor at producing high levels of intellectual attainment within his students. Two of his protégé's, Massieu and Clerc were comparable to their hearing peers in terms of their writing and reasoning skills (Stokoe, 2005). Although Sicard, who was critical of some of the methods used by L'Épée, modified some of L'Épée's signs, but did not introduce a new sign system or form of language when instructing deaf students (Stedt & Moores, 1990).

In 1815, Thomas Hopkins Gallaudet was sent from America to Europe in order to learn the methods of teaching the deaf. He was instructed by Sicard in the methods used by the school in Paris and was sent back to America with Laurent Clerc, who became the first deaf teacher of the deaf in America. Sicard was therefore the link between the development of sign language in France and American Sign Language (Stokoe, 2005). The American School for the Deaf was established in 1817 in Hartford with Gallaudet as the headmaster. Later, the New York School was established. At these two schools as well as the many schools which opened around the country, the medium of instruction used was the natural sign language as well as the methodical sign system originated by L'Épée (Stokoe, 2005). After a year of working at the American School for the Deaf, Clerc developed an English-based sign system which was based on the same principles of L'Épée's methodical signs used to teach French (Stedt & Moores, 1990).

These schools as well as the language flourished to a point where a national college for the deaf was necessitated and established by the Act of Congress in 1864 (Stokoe, 2005). Although the sign system used in America at that time resulted in the need for a college of the deaf, many were sceptical and critical about the types of signs used, the methodical versus natural signs.

The methods used by L'Épée and his successors received criticism from Roch Ambroise Bebian (Lane, 1984 in Stedt and Moores, 1990). Bebian claimed that L'Épée used signs in relation to French only and needed to distort sign language to conform to the rules of the French language. Another critic, Berthier (Lane, 1984 in Stedt and Moores, 1990) objected to the methodical signs used by L'Épée and Sicard as well as the use of the manual alphabet. These views generated debate regarding the type of signs to be used when teaching deaf children.

The debate continued from 1850-1880 (Stedt & Moores, 1990). During this time, there was consensus that the deaf needed to be taught in a sign language or sign system; however the controversy regarding the form of the sign language to be used continued. The major issues were the use of methodical signs, which were based on the morphology and syntax of English, and the use of natural or colloquial signs (Stedt & Moores, 1990). Certain scholars, such as Burnet (in Stedt and Moores, 1990) favoured the use of both methods as he recognised the benefits and limitations of each method. During this time there were strong proponents of both approaches which affected the systems of communication being used in schools for the deaf. Proponents of the methodical sign systems argued that these signs were needed in order for the deaf child to learn English; while advocates of the natural sign method felt that the use of methodical signs were artificial and were not used by the deaf during conversations (Stedt & Moores, 1990). During this period, educators of the deaf were greatly divided on the type of signs to be used. However, there was no evidence on either side to substantiate their claims (Stedt & Moores, 1990).

In 1880, the conference of Milan signified a major transformation in the education of the deaf world-wide. Here, the World Congress of Educators of the Deaf voted for a policy of strict oralism in schools for the deaf (Aarons & Akach, 2002) as it was proclaimed that sign language did not have a place in the education of deaf children (Coryell & Holcomb, 1997). Interestingly, the Deaf delegates were excluded from voting at this conference. This decision led to the exclusion of deaf children being taught by teachers of the deaf and resulted in signed language going underground. Although signed language at an international level was frowned upon as a medium of instruction, deaf people continued to use signs to communicate with one another (Aarons & Akach, 2002).

The sentiments emerging from the conference laid to rest the manual-manual debate as signing was prohibited in classrooms, especially at the pre-adolescent level (Stedt & Moores, 1990). Since the conference in Milan in 1880 sign language continued to be used, however was delayed till the later school years.  Oralism thus caused the sign language controversies to abate and became the more dominant method of teaching in schools for the deaf. However, sign language continued to be used secretly among deaf students even in pure oral schools (Stedt & Moores, 1990). The sign language system continued despite efforts to enforce an oral system of education (Coryell & Holcomb, 1997). Literature regarding sign language during this time is sparse as little attention was paid to manual communication as most schools were using the oral method (Stedt & Moores, 1990).

In the 1950s, interest in sign language was renewed after a publication by Stokoe (Stedt & Moores, 1990) which demonstrated that the components of sign language could be analysed linguistically. This publication prompted new research in the field of sign language and sign systems. In the mid 1960's sign language was again recognised as having a valuable role to play in the education of deaf children. The Babbidge Report (1965 in Coryell and Holcomb, 1997) in America documented the poor quality of deaf education as well as the limited academic achievement of deaf children. The report stated that major changes needed to be made in the way that deaf children were taught (Coryell & Holcomb, 1997). Consequent to the recommendations of the Babbidge report, several philosophies and approaches emerged accentuating the value of sign language in the classroom. These approaches were based on assumptions regarding language development and the accessibility of language input rather than empirical underpinnings. These approaches include Total Communication (TC) and the various systems of Manually Coded English (MCE). These approaches aimed to improve the literacy skills of deaf children by making English visual (Coryell & Holcomb, 1997).

### B.1.1 Instructional and communication approaches

While the oral versus manual debate has been raging for many years, there has also been considerable argument regarding the type of manual or sign system to be used in the pedagogic contexts of deaf children. The type of instructional strategy used in the classroom is reflective of the trends in deaf education which have shifted from one communication philosophy to another – from pure oralism to bilingual education (Coryell & Holcomb, 1997).

The various instructional and communication approaches as well as their benefits and limitations will be outlined.

### B.1.1.1 Oralism

Oralism is based on teaching the deaf or hearing impaired child to communicate in a spoken language. In oral programmes, teaching auditory and speech skills is incorporated in the curriculum. Pupils are expected to wear hearing devices such as hearing aids throughout the day and spoken language is the medium of instruction (Geers & Moog, 1992).

### B.1.1.2 Total Communication

The Total Communication approach is based on the belief that all children need to be taught in a manner that is beneficial to each individual child. This approach includes the use of sign language, fingerspelling, speech, speech-reading and any other appropriate form of communication such as gesture, mime, drawing and writing which benefits the child (Coryell & Holcomb, 1997). Total Communication was based on a philosophy of inclusive education as the individual needs of the deaf child needed to be met. However; in practice, Total Communication became the simultaneous use of speech and sign (simultaneous communication) where children were exposed to both the oral language as well as sign. Total Communication can be seen as a combination of the sign and oral approaches and its creation after the Babbidge Report was possibly a means of placating the advocates of both the oral and manual approaches (Coryell & Holcomb, 1997).

#### B.1.1.2.1 Advantages and disadvantages of Total Communication

The advantages of the Total Communication approach are that it is a child-centred approach which accommodates the unique strengths and weaknesses of individual children. It advocates flexibility in order to adjust to the students' educational and communication needs (Coryell & Holcomb, 1997).

Criticisms of this approach are that one approach cannot meet the needs of all children. It is also not possible to address the needs of each student in a classroom (Scouten, 1984 in Coryell and Holcomb, 1997). It is also not possible for a teacher to be proficient in every mode which the child requires (Bahan, 1989b in Coryell and Holcomb, 1997). Also, Total Communication was often misinterpreted and misapplied (as Sim-Com—see section e) and therefore could not meet the needs of individual children (Coryell & Holcomb, 1997). Data has shown that children tend to develop one or the other mode rather than the simultaneous acquisition of both modes (Jensema and Trybus, 1978 in Geers and Moog, 1992). Also, the mode more frequently used by the child was directly related to the degree of hearing loss; where speech decreased and signing increased with increasing hearing impairment (Geers & Moog, 1992).

**B.1.1.2.2 Total Communication in practice**

A study by Geers and Moog (1984) compared the elicited English language structures of children from oral-aural and TC programmes. The responses were analysed in terms of oral productions of oral-aural children, oral productions of TC children, manual productions of TC children as well as the combined productions of TC children. The major findings of this study were that most of the children in the TC programmes did not simultaneously talk and sign and that their signed productions were significantly better than their oral productions. Their scores for oral productions were below the scores of children in oral-aural programmes. In addition to the spoken productions of oral-aural children being significantly better than the oral productions of TC children, their productions also equalled and exceeded the combined signed and spoken productions of TC children in more than 80% of the categories examined. The data also indicated that profoundly deaf children do not acquire language at a similar rate to their hearing counterparts in both oral and TC programmes.



A later study by Geers and Moog (1992) compared the auditory and speech skills developed by children in total communication and oral environments. Their findings indicated that the children in oral programmes demonstrated significantly better speech perception, speech production and oral communication skills on all the tests administered as compared to the children in TC programmes. They concluded that more research is needed in order to determine whether children in TC programmes are able to acquire similar spoken language skills as children in oral-only programmes.

**B.1.1.3 Manually Coded English**

Concurrent to the development of Total Communication, several forms of manually-coded English systems were devised. Examples include Seeing Essential English- SEE I created by Anthony and Associates (1971 in Coryell and Holcomb, 1997), Signing Exact English SEE II created by Gustason, Pfetzing and Zawolkow (1972 in Coryell and Holcomb, 1997) and Signed English created by Bornstein, Hamilton and Saulnier (1980 in Coryell and Holcomb, 1997). These sign systems have several defining characteristics:

- Systems of Manually Coded English (MCE) are based on American Sign Language (Stedt and Moores, 1990) in which the grammatical inflections and word order of English can be represented (Coryell & Holcomb, 1997).
- Signs for words are determined by three language aspects: the spelling of the word, the pronunciation and the meaning. This meant that if a word in English was similar to another word based on two or more aspects, these words would have the same sign. An example is the word "right" which has many meanings (correct, legal claim, direction) but is similar in terms of spelling and pronunciation. In MCE systems, these multiple meanings for the word "right" would have the same sign. In contrast, American Sign Language would have a sign for each concept which relates to the English word "right" (Coryell & Holcomb, 1997).
- In order to emphasise aspects of the English language which are embedded in Sign Language, MCE systems supply a visual detail to highlight these features. For example, "development" consists of two signs, "develop" and "ment" (Coryell & Holcomb, 1997).
- SEE-I and SEE II systems use literal signs for figurative uses of the English language. For example, "runny nose" would be signed using the sign for run even though a nose cannot run (Luetke-Stahlman, 1991).
- MCE systems are based on the assumption that deaf children have difficulties learning a spoken language such as English—a situation which needs to be remedied. The aim of these systems is to make English visible on the hands by exposing deaf children to the grammar of English. In so doing, deaf children would be provided with similar opportunities for learning as their hearing counterparts who access English auditorily (Coryell & Holcomb, 1997).
- MCE systems have been developed in order to be used by hearing parents and teachers (Stedt & Moores, 1990).



**B.1.1.3.1 Advantages and disadvantages of Manually Coded English systems**

An advantage of MCE systems are that they are designed to be systematic and consistent in their representation of English and are therefore able to be standardised. Also, they are more accessible to family members and teachers of deaf children who are familiar with the syntax and morphology of English. Due to this accessibility, parents may start interacting with the deaf children during the critical years of language development which would promote language acquisition (Coryell & Holcomb, 1997).

MCE systems have been criticised for being artificial and cumbersome and violate the principles of language acquisition (Coryell & Holcomb, 1997) . These systems are considered complex and are not easily processed cognitively. In comparison to ASL, manual forms of English are considered to be lacking in the expressive nature contained in ASL. In addition, MCE systems are not in use by any linguistic community which implies a lack of native language models (Coryell & Holcomb, 1997).

In addition to the above points there is also the concern about the accurate representation of English manually by signers. There have been many studies which prove that there are many production errors by teachers who use these sign systems in the classroom (Coryell & Holcomb, 1997). A study by Luetke-Stahlman (1991) investigated the consistency of teachers when following the rules of SEE I, SEE II and Signed English or Manual English. Their findings indicated that even though teachers believed they were strictly following the rules of a particular system, in practice they were not doing so. Non-adherence to the rules of the system affected the English form which was conveyed and confounded the acquisition of language for hearing impaired children. Teachers did not follow the rules of the system when signing more challenging stimuli and omitted signs for spoken words or markers, borrowed signs from other systems, used incorrect signs and even created signs instead of using cueing and fingerspelling (Luetke-Stahlman, 1991). Accurate representation of English is thus dependent on commitment to one specific system (Coryell & Holcomb, 1997).



**B.1.1.4 Pidgin Sign English (PSE)**

Pidgin Sign English refers to the combination of various elements of English and a Sign Language such as ASL. PSE integrates the English syntax into ASL while maintaining the conceptual integrity of ASL. The main function of PSE is to facilitate communication between deaf people using a Sign Language and hearing people using a spoken language. It has thus evolved as a partial representation of English using ASL signs (Coryell & Holcomb, 1997).

PSE was been promoted as a pedagogic tool or language in classrooms; however its use in academic institutions can be seen as a compromise between students using ASL and teachers who speak English. Deaf students can thus be exposed to the syntax of English while still having the freedom to express themselves in ASL without being encumbered with rules of MCE systems. Although, PSE may be useful in certain contexts; it cannot be applied in classrooms as there is no standard vocabulary as well as no grammatical constraints (Coryell & Holcomb, 1997).

**B.1.1.5 Simultaneous Communication (Sim-Com)**

Sim-Com is the simultaneous use of speech and sign where English word-order is followed. Sim-Com is commonly used between signing and hearing individuals. The use of Sim-Com is based on the assumption that English can be represented manually where there is no deterioration of either the signed or spoke form (Coryell & Holcomb, 1997).

**B.1.1.5.1 Advantages and disadvantages of Sim-Com**

The advantages of Sim-Com are that this approach provides auditory input to the deaf child and allows the deaf child to use speech. The sign and speech systems are seen as being supplementary and the best of both modes are presented in education as well as social settings (Coryell & Holcomb, 1997).

The use of Sim-Com in educational contexts has been criticised as being cumbersome and ineffective as it is not easy to speak and sign at the same time while maintaining the accuracy of the message to be conveyed. When signing and speaking, the rate of speech production is reduced by about 25% as well as the numerous omissions of words. There have been many arguments against the use of Sim-Com as an effective means of communication or method of teaching English due to the lack of clarity, ease and expression with which it is used. The use of Sim-Com results in simplification of the message as well as a distorted pace. There is no evidence to suggest that the use of Sim-Com has a positive effect on the development of English (Coryell & Holcomb, 1997).

**B.1.1.6 Bilingual Education (Sign Language and English)**

In 1988 another congressional report in America criticised the lack of American Sign Language in schools for the deaf. This report was prepared by the Commission on Education of the Deaf which led to the movement to bilingual education. Bilingual education advocates the fluent development of a primary or first language such as Sign Language and the transference of that language knowledge to fluency and literacy in a second language such as English. Deaf and hearing professionals are thus the language models for both these languages (Coryell & Holcomb, 1997).

#### B.1.1.6.1 Advantages and disadvantages of Bilingual Education

The bilingual education model recognises that Sign Language and English are two distinct languages where English cannot effectively be represented in a signed form (Coryell & Holcomb, 1997). This model also recognises that deaf people may belong to both the Deaf and mainstream communities. The bilingual approach is supported by many members of the Deaf community as well as professionals in the field (Coryell & Holcomb, 1997).

Opponents of the approach emphasise the limited time spent on English development and speech training. Another vital issue is that of proficient sign language models in schools as well as the training of professionals in Bilingual Education approaches (Coryell & Holcomb, 1997).

## B.2 The historical context of deafness and Sign Language in South Africa

### B.2.1 The development of signed language

In South Africa, as is the case in many other countries, the history of sign language is linked to the development of schools for the deaf as sign language developed where there were communities of deaf people (Aarons & Akach, 2002). The history of schools for the deaf in South Africa is a complex one where schools were racially and linguistically divided. A historical overview of the establishment of these schools provides an insightful look into how schools were divided in terms of race and also communication practices which has led to the current scenario of schools for the Deaf in South Africa.

Schools for the deaf in this country were first established by religious groups in the nineteenth century (Vermeerbergen et al, 2007). The churches most involved were the Dominican Catholic Church and the Dutch Reformed Church (Aarons & Akach, 2002). The history of South African Sign Language can be traced back to these residential schools for the deaf; however it is possible that some form of signed language existed prior to the establishment of these schools (Reagan, Penn & Ogilvy, 2006). The first school for the Deaf in South Africa was established in Cape Town in 1863 under the leadership of Bishop Grimley from the Irish Dominican Order. This school used signed language as a medium of instruction and catered for all race groups. The Irish Dominican nuns promoted the use of a signed language due to the influence of the work done by the Abbé Charles-Michel de L'Epée. Although Britain and Germany were adhering to policies of oralism at that time, education for deaf children were controlled by the Catholic Church where the French policy of manualism was firmly established. In 1904, manualism was still predominantly used in this school. At that same time, two other schools for the deaf had been established which served only white deaf children. The Worcester School for the Deaf and Blind was established in 1881 by the Dutch Reformed Church to accommodate the children of Dutch settlers. This school promoted the combination of oral and manual methods. According to folklore, a Dutch Reformed Church missionary, Jan de la Bat taught his deaf brother by means of signs. These signs became the major underpinning of the type of signs used in Worcester today which the community claims is native to the area (Aarons & Akach, 2002).

The other school was established by German Dominican nuns in King Williamstown in the Eastern Cape. This school, which served the "European Deaf", was strictly oral due to the influence of oralism in Germany. The school later moved to Johannesburg where it became St. Vincent's School for the Deaf and continued to serve only white children (Aarons & Akach, 2002).

Another school for the deaf was established in 1933 by the Dutch Reformed Church to serve the coloured deaf. The school, Nuwe Hoop adopted the same policy as the Worcester school for white children which was spoken Afrikaans and some manualism. The Grimley Institute for the Deaf in Cape Town, while being racially integrated, segregated the children in the 1920's according to whether they would use oralism or manualism. This decision occurred subsequent to a visit by one of the sisters to the German School in King Williamstown and resulted in a policy of oralism for all but the most 'backward' children being adopted. In 1937 a separate school for non-Europeans was established by the Irish Dominicans in Wittebome, Cape Town where both coloured and African children were admitted. However, in 1953 the laws of the apartheid government further segregated the schools and this school then admitted coloured children only (Aarons & Akach, 2002).

These institutions had an influential role in developing formal educational policy; however were not the major centres for the development of sign language in South Africa. Schools for the deaf initially encouraged the use of sign language; however its use was separated from classroom instruction and was only used as a medium of instruction again after 1948 (Reagan, Penn & Ogilvy, 2006).

In the 1960's the Dominican Grimley School which catered for white children moved to Hout Bay where a strict policy of oralism was implemented and still continues. Pupils at this school are forbidden from signing and are separated from any signers (Aarons & Akach, 2002).

In 1962, a school for African deaf children was established in Hammanskraal as there were African children who wanted to attend the Wittebome School. The school in Hammanskraal was also founded by the Irish Dominican nuns and was about 1600 km away from Wittebome School. The fact that there was no school for African children in the Western Cape at that time was in concurrence with Nationalist's government's policy on influx control where no African children officially belonged to the Western Cape. In 1986, when this policy was abolished, the Dutch Reformed Church set up a school for the African deaf children in Khayelitsha (Aarons & Akach, 2002).

The first school for African deaf children, Khutlwanong, was established in 1941 in the Transvaal by the Johannesburg Deaf and Dumb Society and was later directed by the Dutch Reformed Church trustees. A system of signs, known as the Paget-Gorman system was introduced at this school where teachers and pupils had to simultaneously speak and use this system of signs. This British system of signs consists of invented signs and does not have a grammar of its own. This system spread to other African schools for the Deaf (Aarons & Akach, 2002).

In accord with the homelands policy, a number of schools for the deaf for African children were established in the 1950's according to the spoken language of each ethnic group. As a result, there was a school for Tswana, South Sotho and North Sotho "speakers" in Rustenberg; a school for Xhosa "speakers" in the Eastern Cape; a school for Tswana and South Sotho "speakers" at Thaba'nchu and a school for Zulu "speakers" at Nkandla. A few other schools were also established to serve the deaf children of each ethnic group where the spoken language of that group was used as the separating factor (Aarons & Akach, 2002).

The medium of instruction in these schools was the mother tongue; which in the case of deaf children is a complex issue as deaf children cannot hear their mother tongue. The schools were required to integrate the Paget-Gorman system with the spoken mother tongue. Later, English or Afrikaans was introduced as the official medium of instruction in addition to the use of the Paget-Gorman system. The division of schools on the basis of mother tongue became inconsistent and confusing as the official language practices, which declared that signs had to be used in conjunction with a spoken language, resulted in less accessibility to communication (Aarons & Akach, 2002).

Despite an official policy of oralism in all schools (Aarons & Akach, 2002), schools for black deaf children used manual sign codes for spoken languages whereas schools for white deaf children strictly used the oral modality for communication (Reagan, Penn & Ogilvy, 2006). Spoken language (English and Afrikaans) was perceived as the more prestigious form (Vermeerbergen et al, 2007) and required more in terms of resources. Schools for white children were at an economic advantage as they were more equipped to provide hearing devices such as hearing aids as well as intensive speech and language therapy (Reagan, Penn & Ogilvy, 2006). However, oralism has not been a successful method of teaching deaf children as deaf children cannot learn to hear and may only learn to speak up to a certain point (Aarons & Akach, 1999).

On the other hand, schools for black deaf children were not well resourced, funded and staffed and the children were not prohibited from signing (Aarons & Akach, 2002). Staff working with the deaf adults and children at these schools noticed a disparity between the signing used in the classroom and the signing that was used in the surrounding deaf community for social purposes. The signs used in the classroom were largely derived from the book "Talking to the deaf/ Praat met die dowes" (Nieder-Heitmann, 1980 in Reagan, Penn and Ogilvy, 2006) which were based on a combination of signs from the Paget-Gorman system, Gestuno and Nieder-Heitmann's own knowledge of South African signs. The sign language used in classrooms was not a sign language but was rather a manually coded form of English which differed greatly from the signing used in deaf communities (Reagan, Penn & Ogilvy, 2006).

Towards the end of the apartheid era, a new educational philosophy was adopted by most schools for the deaf in the country– that of Total Communication. This educational philosophy, which was not conceived as a teaching methodology, manifested as the simultaneous use of spoken language and sign (Reagan, Penn & Ogilvy, 2006). According to Aarons and Akach (2002: 134, italics in original) total communication was in practice an *ad hoc* system of sign-supported speech which in practice resulted in minimal to no communicative effect. It is not clear whether the spoken language used was English, Afrikaans or an African language. The practice of total communication was accelerated towards the end of the apartheid regime when a single education system was adopted for all students (Reagan, Penn & Ogilvy, 2006).

Due to the fact that the children in the black residential schools were "largely left to their own devices", sign language was allowed to thrive and develop despite an official oralist policy (Aarons & Akach, 2002) (134). These children were allowed to sign to each other and less time was spent teaching them to speak. Consequently, these schools became centres where natural signed languages were developed outside of the classrooms despite the fact that these black deaf children were subjected to an appalling general education (Aarons & Akach, 2002).

In the 1950's, schools for white deaf children from Afrikaans-speaking families were established in Pretoria (Trans-Oranje School) and the Free State under the auspices of the Dutch Reformed Church. In 1958, the Fulton School was established in Natal by the Anglican Church for children from English-speaking homes. The V.N. Naik School was established for Indian Deaf children in Natal when an Indian teacher was trained by nuns at the Wittebome School. Later, the M.C. Karbai School was established in Lenasia, also for Indian Deaf children (Aarons & Akach, 2002).

It can thus be seen that the legislation of the apartheid government had a separating effect on the pedagogy used – oral versus manual communication. Another form of separation was the type of education received. White deaf children have historically received a more "academic" education whereas black deaf children were exposed to a more practical and vocational curriculum (Storbeck, 2005).

Since colonisation and the provision of public education, churches became the main source for deaf schools being established as the state took little or no responsibility to do so. The state funded some schools during the course of the twentieth century once they were established. Education for deaf children only became mandatory in 1996 with the implementation of the new constitution. Consequently, there were more deaf children (before 1994) who had never been to school than those who had attended a school at some time (Aarons & Akach, 2002).

In recent years, the trend has shifted to a more bilingual approach which emphasises the use of South African Sign Language (SASL) and spoken language (Reagan, Penn & Ogilvy, 2006). This approach is compatible with the current educational language policy which advocates multilingualism and emphasises that children become proficient in at least two languages (Department of Education, 2002).

### B.2.2 The spread of signed language in South Africa

Once the various schools for black deaf children had become centres where sign language flourished outside of the classroom, sign language was then able to be spread as these students returned home or moved around the country. Due to apartheid in education, many deaf children had to leave their homes. On returning home or moving to other areas for work, sign language was able to be spread as deaf people would socialise with other deaf people. Deaf people are also being exposed to different sectors of the deaf community due to programmes on television as well as interpreting of the national news. There are currently many local and national events such as sport, cultural and educational events for deaf people as well as forums and indabas. Deaf people are also training other deaf people to teach sign language despite being from different signing communities (Aarons & Akach, 2002).

## Appendix C: Background to the Education Policy

In 1996, two task teams were assigned by the Ministry of Education to investigate the position of 'special needs and support services' in South Africa. The two task teams—the National Commission on Special Needs in Education and Training (NCSNET) and the National Committee on Education and Support Services (NCESS) were required to jointly investigate and identify the needs and priorities to be addressed; to develop a conceptual framework for 'special needs' and support services based on a 'holistic and integrated approach'; to provide the principles and strategies of inclusion and mainstreaming; to examine the implications for education as a whole as well as to develop a plan for the implementation of the new national policy (Department of Education, 1997): 4. The task teams' recommendations were used to inform and underpin the development of a new national policy for children with special needs.

The NCESS and NCSNET Report (1997) identified that education for children with special needs was based on segregation, inequality and disparity based along racial lines as well as disability. Segregation was apparent at the level of policy where separate education departments were governed by different legislation. In 1948, the State's adopted policy of separate development had a significant impact on special education and resulted in inequalities in service provision related to race. This legislation led to the establishment of homelands, the Bantu Education Act (1953), the Indian Education Act (1965) and the Coloured Persons Education Act (1963) (Department of Education, 1997).

According to the NCESS and NCSNET Report (1997), the sector of "special needs" was further segregated by legislation based on separating the "ordinary" child within mainstream education from the child in the "special needs" system (Department of Education, 1997: 22). There existed a division between education support services and "special needs education" which was then further divided from mainstream education. Children who were faced with barriers to learning were labelled and isolated from their peers. These sectors were separated by rigid boundaries and bureaucracies which were inclined to provide services to a limited number of individuals within urban areas (Department of Education, 1997: 3).

The NCSNET and NCESS Report (1997) made several recommendations which were adopted in the education policy. It would appear that change in education was necessary at that time and needed to reflect the change in political climate. It seems that the members of the NCESS and NCSNET task teams were determined to propose change at all levels of special needs education as their recommendations were aimed at “transforming all aspects of the education system” and “developing an integrated system of education” (Department of Education, 1997). Their recommendations therefore may have been influenced by preconceived notions of what the new education policy should encapsulate.

The recommendations of the NCESS and NCSNET seem highly ideological and influenced by the need to transform the situation of special needs education. The report states that the findings of the task teams were based on research, consultation with key stakeholders as well as internal debate within the NCSNET/NCESS (Department of Education, 1997). There is no evidence to suggest that any form of empirical research was conducted which informed their investigation and hence the recommendations that were made. The recommendations are thus based on the perceptions and observations of the stakeholders involved. The lack of empirical evidence in the adoption of inclusive education is equivalent to the situation in the United Kingdom where an author stated that: “The push for inclusion in education sometimes appears politically driven and backed by statements of faith rather than evidence” (Powers, 2002: 232).

Despite lack of empirical research, the barriers identified and recommendations made by the NCESS and NCSNET provided the major underpinnings for the current education policy. The policy for children with special needs reflects the new form of consciousness which the current government wanted to embody— an altered perception of children with special needs as well as a caring and humane society (Department of Education, 2001).

# Appendix D: The Inclusive Model

## D.1 Introduction

According to the Education White Paper 6 (2001), the Inclusive Education and Training Framework recognises that all children and youth can learn and that they require support. Inclusive education requires that children's individual needs be accommodated through education structures, systems and learning methodologies. Individual learner needs should also be met through changes in attitudes, behaviour, teaching methodologies, curricula and the environment. Learner differences in terms of age, gender, ethnicity, language, class, disability or HIV status need to be respected. Inclusive education recognises the learning that occurs within the broader community and home and within formal and informal structures. The inclusive model advocates that barriers to learning be minimised and learner participation in the culture and curricula of educational institutions be maximised. In order for children to critically participate in the learning process, they need to be empowered by developing their individual strengths (Department of Education, 2001: 16). The inclusive model recognises the individual needs of children who experience barriers to learning and advocates that said barriers be removed or minimised.

The major barrier experienced by deaf children is that of access to the curriculum. Deaf children need to access the curriculum through a sign language medium as they are unable to hear spoken language. However, the issue of sign language in schools for the deaf is a complicated one and is fraught with problems such as the use of a uniform system such as South African Sign Language (SASL) as well as teacher proficiency and qualifications in SASL.

## D.2 The role of Special Schools in the Inclusive Model

According to Education White Paper 6 (2001) the organisation of an inclusive education system provides various levels of support to learners and educators. Children who require low and moderate levels of support should be accommodated in ordinary and full-service schools. Children who require high-intensive educational support should be accommodated in special schools (Department of Education, 2001) (15). Children who are deaf and require access to the curriculum through sign language, should be accommodated in specialised centres or special schools. For the purposes of the current study, the role of the special school will be described in more detail.

The policy advocates the strengthening of special schools, rather than their abolishment where the roles of special schools will be expanded. Staff at special schools will be expected to play a greater role in providing expertise and support in curriculum, assessment and instruction as part of the district support team to neighbourhood schools. They are also expected to provide services to learners who require support within mainstream settings as well as to provide support to mainstream schools (Department of Education, 2005). Teachers at special schools are required to fulfil a wider range of duties and need to become a support base or resource for full-service and ordinary schools within the neighbourhood. Teachers at schools for the deaf do not receive adequate support in terms of training needed to teach deaf children in their own schools, however policy requires that these teachers provide services of a supportive nature to teachers in mainstream schools. The policy is not clear on the extent to which the district-based support teams will provide much-needed guidance to teachers in special schools.

# Appendix E: Sign Language

## E.1 General features

It is now linguistically accepted that the natural signed languages used by the deaf throughout the world are complete languages which are comparable to all other studied natural languages (Aarons & Akach, 2002). Through the medium of a signed language, the same range of human experience can be expressed as these languages have as many registers and are as complex as any spoken language (Aarons & Akach, 2002). Signed languages can be represented at phonological, morphological, syntactic and semantic levels; however can be differentiated from spoken language in terms of the medium through which it is represented. Signed language is formed through the medium of space, not sound, using the hands, face, head and upper torso for its realisation (Aarons & Akach, 2002).

Like spoken languages, signed languages arise naturally through a community of users which evolve and develop naturally over time as it is passed down through the generations (Aarons & Akach, 2002). A difference between signed and spoken languages is that it is usually the case that deaf children do not learn a signed language from their parents as only 10% of deaf children are born to deaf parents (Aarons & Akach, 2002). Deaf children usually learn sign language from other deaf children and adults.

The fact that deaf children learn sign language from other deaf children and adults coupled with the fact that sign language has no written form leads to high levels of variability within the sign language used by a community. Generally, the signed language used in one country is distinct from the signed language in another, especially if these countries have no geographical and historical association. Signed languages are not based on and do not have a relation to the spoken language of the geographical area in which they occur (Aarons & Akach, 2002)

## E.2 South African Sign Language (SASL)

South African Sign Language is a natural language and serves as the primary vernacular for many deaf people (Reagan, Penn & Ogilvy, 2006). According to the Deaf Federation of South Africa (DeafSA), there are more than the 383 408 deaf persons as identified by the 1996 census in South Africa. The reason for this belief is that disabled people in South Africa are undercounted due to the stigma attached to people identifying themselves as disabled (DeafSA, 2006).

Reagan et al (2006) highlight some important facts about SASL. SASL varies considerably in terms of the lexicon based on regional and educational background which reflects the diversity of the population. This variation in lexicon tends to be moving toward a more uniform state. In comparison, the syntactic structure is characterised by a homogeneity which tends to unify SASL. In short, SASL has many lexical variances which now seem to be converging. The syntactic features of the different regional varieties of SASL seem to be similar. Although SASL is similar to other natural sign languages such as American Sign Language (ASL) and British Sign Language (BSL) syntactically, it is not identical to these languages (Reagan, Penn & Ogilvy, 2006). SASL has some influence from Irish SL but less so from BSL (Aarons & Akach, 2002)

Reagan et al (2006: 196) confirm the following based on research:

"…SASL is a distinct language in its own right, not a derivational or pidgin language, in that it is a rule-governed, grammatical, systematic and non-arbitrary communication system similar in nature to other natural signed languages."

Their evidence also shows that SASL is primarily characterised by spatial relationships, however there are other significant factors that also play a role (Reagan, Penn & Ogilvy, 2006).

According to Reagan (2007) all languages are characterised by linguistic universals. Similarly, sign languages are also characterised by common linguistic structures. Like other natural signed languages, SASL has phonology, morphology, syntax and pragmatics governed by the same principles as other human languages (UNESCO, 1999). The report further states that signed languages are not based on spoken languages as they have independent grammars. Sign language is also able to convey idiomatic expression (DeafSA, 2006).

**E.2.1 Are there different Sign Languages in South Africa?**

Anecdotal evidence suggests that many deaf people believe that there are many different varieties of sign language in South Africa; however most deaf South Africans are easily able to communicate with one another (Aarons & Akach, 2002). While it is the current understanding that the different varieties of sign languages are converging, this was not the case during the apartheid years when sign languages were seen to be specific to its geographical location.

In 1983, a conference at the Human Sciences Research Council in Pretoria led to the formation of the South African Sign Language Research Programme (SASLRP). The main function of the SASLRP was to produce a dictionary depicting the actual signs used by deaf adults in South Africa which was to be used in educational settings. The aim of the dictionary was to simplify, codify and combine a single sign language which could then be used in education settings for deaf children. However, problems arose when it became apparent to the researchers that extensive diversity existed in the signs used by various deaf communities due to the disparities of apartheid. This linguistic diversity existed at the level of the geographic, ethnic and even educational as some signs were specific to certain schools. It was decided that to impose a created sign language on the various communities would be unethical and would also have significant pedagogic implications. The decision then was to document the different forms of the signs used and to empower the deaf to make their own decisions around their language (Penn, 1994 in Reagan et al, 2006). Deaf groups and individual were important stake-holders in the process and were involved in vital policy-making decisions. To the researchers, it became apparent that while lexical diversity existed among the signs, there seemed to be uniformity with regard to the syntactic components of Sign Language. The final product, the "Dictionary of Southern African Signs" led to national attention to Sign Language and allowed previous historical barriers between various deaf communities to be overcome (Reagan, Penn & Ogilvy, 2006).

The "Dictionary of Southern African Signs" was criticised as being based on a false hypothesis regarding the effect of apartheid on the signed languages used in South Africa (Aarons & Akach, 2002). The dictionary also presumed that there was a close relationship between words and signs and seemed to make the assumption that there is a word for every sign and vice versa. It also seemed to indicate that signed languages are comparable to the spoken languages they represent in terms of morphology and syntax. Another criticism was that the dictionary failed to recognise that signs vary within the different contexts. Aarons and Akach (2002) further comment that although different varieties of signed languages exist in South Africa, these varieties are controlled by deaf people as is the case of many spoken languages (Aarons & Akach, 2002).

### E.2.2 The Syntactic Features of South African Sign Language (SASL)

SASL is a spatial language which uses the medium of space maximally to communicate the relationship of the elements of the language to one another. It takes approximately the same time span to express an idea in Sign Language as it does in a spoken language. Although in certain cases individual words can be expressed faster in spoke form, Sign Language can express many different pieces of information simultaneously in one sign (Aarons & Akach, 1999).

The structure of SASL consists of four important parameters. These parameters are handshape, orientation of palm, location and movement (Sign Language Education Development (SLED), 2006). These parameters form the phonological system of SASL and can be formed simultaneously as they occur in space (Aarons & Akach, 1999). In space, the manual articulators, i.e. hands are used with non-manual articulators i.e. eyes, mouth, face, head, shoulders, etc. (SLED, 2006). Similar to spoken languages, signs are also formed through a sequential organisation of units; where the signs are formed by a sequence of movements and holds which can be equated to the concatenation of consonants and vowels in spoken language (Aarons & Akach, 1999). Signed and spoken languages are thus similar in that they can be expressed sequentially as well as simultaneously. A difference between spoken and Sign Language is that spoken language uses the medium of sound, whereas sign language uses the medium of space (Aarons & Akach, 1999).

The handshape is described as the “phonetic alphabet” of Sign Language. Handshapes can be iconic, metaphorical or arbitrary. Although, it was formerly thought that most signs were iconic, recent research has shown that 70% of signs are arbitrary (SLED, 2006).

SASL has three main categories of signs. These are one-handed signs which are made using only one hand, two-handed signs where one hands is the articulator as well as two-handed signs where both hands are symmetrical or complimentary to each other. Signs can also be non-manual where no hands are used but meaning is conveyed through the use of other parts of the body such as facial expression (SLED, 2006).

Sign language makes extensive use of classifiers which are also used in spoken languages such as Navajo and Mandarin. There are different types of classifiers such as size and shape classifiers, e.g. BED; tracing classifiers, e.g. WINDOW, handling classifiers, e.g. FISHING ROD; instrumental classifiers, e.g. KNIFE and touch classifiers, e.g. PIANO. Classifiers can functions as nouns and/or verbs and can indicate manner and location (SLED, 2006).

## Appendix F: Literature Review on the Topics of *Integers*, *Fractions* and *Time*

The next section presents the literature pertaining to studies regarding the mathematics topics taught to deaf learners during the study.

### F.1 Integers

Counting numbers are constructed from real objects and quantities and the operations performed thereon are related to concrete manipulations. The teaching of negative numbers usually requires that children make use of an algebraic frame of reference for the first time. The properties of negative numbers and operations performed thereon are given meaning through formal mathematical reasoning (Williams & Linchevski, 1997).

Two alternatives for teaching children about negative numbers are proposed (Williams & Linchevski, 1997). The first suggests that all forms of attaching practical meaning to negative numbers be avoided and to treat them formally from the beginning, as negative numbers cannot be described realistically and directly and can only be deduced at a formal level (Fischbein, 1987; Freudenthal, 1973 in Williams and Linchevski, 1997). An alternative is the use of models to provide students with a practical intuitive meaning for negative numbers, the operations performed on them as well as the relations between them (Liebeck, 1990; Linchevski & Williams, 1999).



The use of models needed to construct contexts that explained why subtracting an integer was the same as adding its opposite or why a negative multiplied by a negative was a positive; or risk becoming as meaningless to students as abstract mathematical rules. The model needed to create a realistic connection to integer operations which was not contrived (Gregg & Gregg, 2007) and needed to describe a reality that was meaningful to the student (Williams & Linchevski, 1997).

In the literature, various models or games were used to create awareness about negative numbers. Also, the use of the number line was used extensively in classrooms to represent the addition and subtraction of negative numbers. Liebeck (1990) questioned the value of using a number line to model subtraction in terms of shifts along the number line. He concluded that by presenting an alternative intuitive model, addition and subtraction maintained their original physical interpretation of “add” and “take away”. The pupils were able to construct their own strategies and were better able to extend their strategies than the number line group were able to extend their rules (Liebeck, 1990). Models such as the charged particle model and the number line model led to students becoming confused and frustrated and the model was often a distraction rather than an enhancement to the learning environment (Petrella, 2001).

Linchevski and Williams (1999) devised an instructional instrument which aimed at filling the cognitive gaps in grade 6 children’s mathematical development, where operational conceptions such as subtraction gave rise to structural conceptions such as the concept of negative number. The instructional method was based on children’s everyday common sense and intuition where meaning was provided by the manipulation of objects within familiar contexts. The authors concluded that no single model can be both intuitive and comprehensive. They reported that their model could not be extended from addition and subtraction to multiplication and division, which possibly required a purely algebraic approach (Linchevski & Williams, 1999).

In Japan, work on integers usually commenced in elementary school where integers as a mathematical concept was introduced, specifically the understanding the number zero, positive integers and positive fractions. Later, the arithmetic operations were applied (Takagaki & Shimuzu, 2011). The sequential development of integers is that students are firstly, able to construct integers as composite units, i.e. the ability to represent a given integer in a number of ways, e.g. $-5$ as $-5+0$, $-4+-1$ and $-3+-2$. The ability to represent integers as quantities, led to a basis for understanding the operations performed on integers (Gregg & Gregg, 2007). Teaching about the addition of integers is dependent on learners’ knowledge of the equivalent forms of integers (Rowland, 1982). An experiment by Rowland (1982) concluded that the four 11-year old participants were able to use addition quite easily after a series of lessons using differently coloured cubes to represent positive and negative numbers. They were able to arrive at a procedure for subtracting integers which he described as “both meaningful and successful” (Rowland, 1982: 26).

Children first learn about subtraction using natural numbers, by taking away objects such as counters. The operation of subtraction is viewed as complementary to addition, as $5 - 2 = x$ and $2 + x = 5$, produces the same answer. With integers, subtraction is performed by adding the additive inverse (Rowland, 1982). Rowland's experiment concluded that when the additive inverse viewpoint was eventually conceptualised through experiential learning, students were able to make insights into subtraction of integers. An effective way to explain the rule "to subtract an integer, simply add it's opposite", a teacher used the example of positive and negative outlooks on life. The students were then able to understand the rule based on the idea that "to take away a little negative, we add a little positive". Using this type of example, the phrase "to take away" allowed the children to make a natural connection between the subtraction of integers and the subtraction of whole numbers which occurs at a much earlier developmental level (Petrella, 2001).

A paper by Ball (1993) reported that using an elevator model failed to challenge 9-year old children's tendency to conceptualise negative numbers as being the same as zero. The same applied to models using money and models. Money was a useful representational context for learning about negative numbers as relative quantities could be modelled. For example, that -5 was less than -2, even though 5 was more than 2. Also, money was useful for addition and subtraction of negative numbers. However there were limitations to the money model in that many children didn't use negative numbers to represent debt. They were inclined to conceptualise money owned and owed as separate rather than using a negative number to represent debt (Ball, 1993).

Using the elevator model, learners were able to order integers and explain why (e.g., "-35 was below zero and 6 was above zero so -35 was less than 6" (Ball, 1993: 383). They acquired that there was no "smallest number." Conceptualising the comparison between negative numbers required a deeper understanding of negative numbers as was shown by her study. About half of the learners, produced a number more than -4 (e.g. -2) when asked to produce a number less than -4. It was easier for the students to identify that -35 was less than 6 (because it was below zero and 6 was above) than to identify that it was less than -6. When presented with -35 and -6, they were inclined to think that -35 is greater than -6, due to the magnitude of the numbers (Ball, 1993).

Good teaching is dependent on using meaningful representations. There is not one, single representation that captures all aspects of an idea, nor would it be feasible to accept that all representations are equally useful for students (Ball, 1993). Also, the use of outside-school experiences should be validated by their success in supporting authentic classroom activities, allowing children to make shifts from intuitive meanings to mathematical meanings (Linchevski & Williams, 1999).

### F.2 Fractions and Rational Numbers

Rational numbers are used to represent quantities that are smaller than the unit used for counting and are also used to represent ratios between quantities. The term "fraction" is commonly used in primary school to represent quantities that cannot be represented by a single whole number. The terms "fraction" and "rational number" can be used interchangeably. Research has shown that children have greater difficulty learning to use rational numbers than natural numbers, i.e. they have greater difficulty forming connections between rational numbers and the quantities they represent (Nunes & Bryant, 2009).

#### F.2.1 Important Features of Rational Numbers

**a) Equivalence and Order**

The understanding of *equivalence* and *order* are important concepts for children in the domains of both natural and rational numbers. Piaget (1952 in Nunes and Bryant, 2009) indicated that learning to count helped children learn both equivalence and order for natural numbers. For rational numbers, these concepts present more difficulty for children as two fractional quantities with different labels can be equivalent, e.g. $\frac{1}{3}$ represents the same quantity as $\frac{2}{6}$. Also, knowledge of the order of natural numbers cannot be transferred to rational numbers. The numerator and denominators affect the order of magnitude of the fraction, however in different ways. A constant denominator with a larger numerator represents a bigger fraction. If the numerator is constant, the larger the denominator, the smaller is the fraction. Studies (Hart et al, 1985; Nunes et al, 2006 in Nunes and Bryant) have shown that children have greater difficulty ordering fractions where the numerators are the same and the denominators different as they had to consider the fractions differently to how they would order natural numbers (Nunes & Bryant, 2009). Children need to understand the equivalence of fractions prior to performing operations, such as addition over them (Rowland, 1982).

**b) Two numerical signs**

Rational numbers consist of two numerical signs to represent a single quantity. There exists a multiplicative relation between the numerator and denominator. The numerator and denominator cannot be viewed independently; however has been shown to be a difficult concept for 11 to 13-year-olds to understand (Stafylidou and Vosniadou, 2004 in Nunes and Bryant).

**c) Density**

Another difficulty for students is the understanding of the density of rational numbers, i.e. that there are an infinite number of fractions between 1 and 2 (Nunes & Bryant, 2009).

**d) Multiplicative Inverse**

The property of multiplicative inverse (e.g. the inverse of $\frac{2}{3}$ is $\frac{3}{2}$) becomes important in the learning of the division algorithm and is also a requirement for learning algebra. Booth (1981 in Nunes and Bryant) found that children have a limited understanding of the inverse relations of fractions which limits their understanding of algebra.

**e) Two common written notations**

It is necessary for children to establish that $\frac{1}{2}$ and 0.5 are conceptually the same number with different notations. Although there are disagreements regarding the order of teaching the notations as well as the need for learning both notations in primary school, no research has shown that one notation be used in favour of the other (Nunes & Bryant, 2009).

**F.2.2 Schemes of actions in division**

Because rational numbers are within the domain of quotients, it becomes necessary to determine children's understanding of rational numbers through their comprehension of division. The schemes of action used by children in division are *partitioning* and *correspondences* (Nunes & Bryant, 2009).

### a) Correspondences

Fractions are also used to represent quantities in *quotient situations*. Two quantities x (dividend) and y (divisor) are divided to form $\frac{x}{y}$. An example of a quotient situation is when 3 chocolates ($x$) are divided among 5 children ($y$). The fractional symbol $\frac{x}{y}$ represents the division (3 ÷ 5) as well as the quantity to be received ($\frac{3}{5}$). The action scheme used by children in these situations is that of *correspondences* where connections are established between portions and recipients. The difference between partitioning and correspondences are that partitioning uses a single whole and correspondences consist of two quantities (Nunes & Bryant, 2009).

A review by Nunes and Bryant regarding studies on correspondences showed that children are able to learn about the relationship between dividend and divisor from their experiences of sharing when the correspondences between the shared quantities and recipients are established. When correspondences are used to understand the relations between quantities, children are then able to make a smooth transition from natural numbers to rational numbers. Approximately one third of five-year-olds, half of six-year-olds and most seven-year-olds were able to use correspondences to make deductions about equivalence and order in tasks where fractions were presented. The positive results of these studies differ with the literature detailing children's difficulties with fractions, possibly indicating that their difficulties may originate from the use of partitioning as a starting point for teaching fractions.



### b) Partitioning

Partitioning is the scheme used by children in *part-whole* tasks where a single quantity or whole is divided into a certain number of parts ($y$) from which a specified number is taken ($x$). The quantity can be represented by the symbol $\frac{x}{y}$. From the outset, it should be clear that the cutting of a whole into parts should have the aim of obtaining a pre-determined number of equal parts. The use of partitioning results in children gaining an understanding of the principles of rational numbers, such as ordering and equivalence. For example, the more parts a whole is cut into, the smaller the parts will be (ordering). Also, twice as many parts would result in each part being halved in size (equivalence) (Nunes & Bryant, 2009).

Partitioning shows a slower developmental process than correspondence. Partitioning requires that children are able to anticipate the solution so that the correct number of cuts produces the correct number of equal parts and exhausts the whole. Once achieved, the action of partitioning does not produce immediate insights into equivalence and ordering of fractions. Many children do not deem it necessary for halves of two identical wholes to be the same, despite being taught about the equivalence of fractions. Also, children may have developed some insight into the concept of inverse relation with partitioning, however were only able to do so when the dividend remained constant. Their knowledge could not be extended to situations where the numerator and denominator were different. Children who developed their conception of fractions through partitioning presented with uneasiness when faced with improper fractions. However, their uneasiness could be overcome by thinking of more than one whole (Nunes & Bryant, 2009).

### F.2.3 Equivalence and order of rational numbers

Procedures to establish the equivalence and order of fractions are complex, especially when both the denominator and numerator are different. Different procedures are used in different countries. In the UK, the most commonly used procedure to determine whether two fractions are equivalent is to analyse the multiplicative relation between or within the fractions. Although students were taught these procedures; studies showed that variations in terms of the fractions used, resulted in poor performance. Children thus have difficulty applying the procedures for equivalence consistently. The importance of understanding equivalence is imperative in the domain of rational numbers as these numbers must be equivalent in order to be added and subtracted. Children should therefore have insight into why fractions are converted to common denominators before they can be added or subtracted (Nunes & Bryant, 2009).

### F.2.4 Conceptual versus Procedural Knowledge

Discrepancies between students' procedural and conceptual knowledge have been found in studies regarding equivalent fractions, i.e. students can learn procedures without understanding the conceptual importance thereof. There has been much debate in mathematics teaching regarding the relative weight to be given to conceptual understanding and procedural knowledge in teaching. Children who are able to link their knowledge of procedures to conceptual understanding are better able to problem-solve with fractions than those children who are able to apply the procedures but show less understanding.

#### F.2.5 Informal Knowledge

Children’s informal knowledge of quantities can also be used to a greater extent in classrooms to firstly consolidate their knowledge about fractional quantities in different situations as a means of preparing them for using formal representations. Between the ages of five and seven years, children may not be able to use partitioning, however they are able to comprehend the consequences of sharing, e.g. the more recipients to share a chocolate, the smaller the portion each one will receive. It is unlikely at this stage that they have connected the understanding of quantities to fractional representations. It is only through schooling that their understanding of fractional quantities and fractions as numbers can be developed.

### F.3 Time Measurement

Counting and number concepts are closely linked to measuring and measuring concepts, however counting is concerned with distinct objects whereas measuring involves continuous properties such as length, area and volume (Wilson & Rowland, 1993). A definition of measurement includes comparing an object with another object of known size; assessing the extent, quality, value or effect of something; judgement of an object in comparison to a certain standard (Dougherty & Venenciano, 2007). Measurement involves the application of mathematics to quantities in daily life, science and technology (Ryan & Williams, 2007).

#### F.3.1 Units of time

With time measurement, a number represents a discrete number of units of time (e.g. days) which can be structured into subsets of time, e.g. 7 days (Ryan & Williams, 2007).

#### F.3.2 The analogue clock

The analogue clock is a complex scale, essentially consisting of two scales which are circular and comprising indicators for hours and minutes (or fractions of an hour). These scales need to be identified, read separately and co-ordinated. It involves conscious switching for quarter and half turns relative to either the approaching hour or the hour that has passed. Later, these common fractions of a rotation are converted to 15-, 30- and 45-minute intervals and a minute unit for more precise time measurement. Reading of the analogue clock also requires clockwise and anti-clockwise comprehension, e.g. ‘6 minutes past or 6 minutes to’ after determining the hour (Ryan & Williams, 2007).

**F.3.3 Difficulties faced by children**

Time measurement presents difficulty for children right through primary school. A common misconception by 11-year-olds, who participated in the study, is that a minute consists of a 100 seconds causing them to mark 50 seconds halfway along a minute scale marked in 6 intervals. They also had difficulty working out the scale interval (Ryan & Williams, 2007).

A sample of 8-year-old children were asked to select the correct time from 3:45, 2:45; 9:23; 2:40; 3:30; 9:15 and 2:15 when shown an analogue clock where the time indicated was 2:45 or quarter to three. The results showed that the most common errors were 9:15 and 3:45—derived from sensible reasoning. Almost a third of the children confused the hour and minute hands while 11% were confused with the hour involved. The children who read the time as 9:15 had mastered the invisible quarters or 15-minute units; however had not understood the convention for the big and little hands. The children who said 3:45 also understood the invisible quarters; however they thought the little hand should point *to* the hour; however they had not understood the subtlety of the fractional position the hour hand holds between the 2 and 3. The 4% of 8-year-olds who responded with 2:15 may have been making a connection with earlier focus on ‘quarter to’ and ‘quarter past’ the hour readings (Ryan & Williams, 2007).



The eight-year-olds in the study also had difficulty calculating when a cake needed to be taken out of the oven if it had to be baked for 50 minutes and was put into the oven at 9:20. 16% said 9:70 where hour and minutes were treated as separate entities or as a decimal. These errors could occur up to 11 years of age (Ryan & Williams, 2007).

Nine-year-olds in the study had difficulty bridging midday or midnight when calculating time differences. 73% were able to calculate the hours between 2pm and 5 pm whereas only 57% could calculate the hours from 9am to 5pm. 28% of 10-year-olds were able to calculate the number of minutes between 11:15 and 12:45 shown by two analogue clocks—19% used the ‘100 minutes in an hour’ conversion (Ryan & Williams, 2007).

Children should master the analogue clock by 13 years; however 41% say the *hour* hand turns 360° in an hour. This response may be attributed to a concentration issue under test conditions; however is considered a significant percentage (Ryan & Williams, 2007).

**F.3.4 Strategies used to tell the time**

A study by Siegler and McGilly (1989) aimed to identify the types of strategies second and third grade children used when telling the time on an analogue clock. Their results indicated that children first located the number that the hour hand had recently passed in order to determine the hour. They then used a number of different strategies to determine the minutes before or after the hour. These strategies were:

- *Retrieval*: children were able to tell the time without any intervening behaviour. They "could just tell" or "knew it just by looking" (p.203).
- *Counting forward by 5's or by 5's and 1's from the hour*: children counted in 5's from the hour until they reached the mark where the minute hand was if it was at a 5-minute time or until the 5-minute mark immediately before the minute from which they then counted in 1's to reach the minute hand.
- *Counting forward's by 1's from the hour*: Children counted in 1's from the hour until they reached the minute hand, then stated the number of minutes past the hour.
- *Counting forward from an earlier 5-minute-mark*: Children counted forward from a 5-minute mark other than the hour. They would state the number of minutes past the hour based on the starting position and continue counting in 5's or 1's or a combination until the minute hand was reached. The strategy required retrieval and counting. The children used this strategy for 5-minute times (e.g. 10:25) as well as 1-minute times (e.g. 10:28).
- Counting backward from a later 5-minute mark: Children started counting from a 5-minute mark past the position of the minute hand and decrement by 1's until the minute hand was reached. On the rare occasion, children also decremented in 5's or 5's and 1's (Siegler & McGilly, 1989).

The following conclusions were made from the results. Children used the hour (32%) and half hour (17%) positions on the clock from which to start counting. For the rest of the trials they used a variety of the 5-minute marks, except for the 55-minute-mark. Children were more able to identify hour times than 5-minute times and more effective in identifying both of these than 1-minute times. They also found that 5-minute times within the first half hour were more easily identified than those in the second half (Siegler & McGilly, 1989).

# Appendix G: Transcript and Analysis of a Grade Four Lesson on Integers (Lesson One)

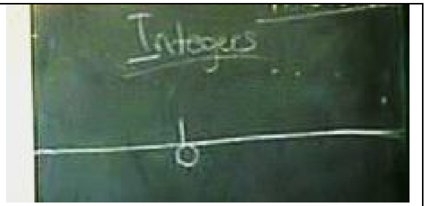
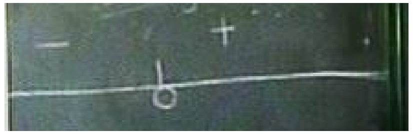
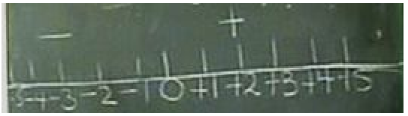
<u>Symbols</u>: T: Teacher's signing or speech
Ll, Lp, Ln, Ls, Lv: Individual learners' signing
T-DVD: Time taken from the DVD which focussed on the teacher
L-DVD: Time taken from the DVD which focussed on the learners

The spoken languages are English and Xhosa. The translation from Xhosa to English is italicised and in brackets. Comments are italicised and written in square brackets



## Evaluative Event 1: Defining the set of integers

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 00:01 | | 1. T: (Has written the topic on the board and underlines it). | |   The topic is indicated on the board at the beginning of the lesson but the teacher does not introduce the topic when signing to the learners. She may not know the sign for the term "integers". |
| 00:08 | | 2. T: Good morning, good morning. How are you? | | |
| | 00:03 | 3. (Learners greet and say they are fine). | | |
| 00:12 | | 4. T: Ok. Firstly, do you see these two (refers to video crew), they are not a problem. They are just visitors. They want to see the grade 4s learning. There's nothing bad about it. Do you hear? Don't worry at all. Everything is fine. Listen well. It's free, free, free. Ok. What day is today? Today? | | |
| | 00:34 | 5. Lv, Lz, Lb: One. | | |
| | 00:35 | 6. Ll, Ln: It's cold. | | |
| 00:41 | | 7. T: What is the date today? | | |
| | 00:38 | 8. Lv, Lz: November. | | |
| 00:43 | | 9. T: November. What is the date? | | |
| | 00:39 | 10. Ll, Lz, Lv, Lb, Ln: It's the first. | | |
| 00:45 | | 11. T: Ok, it's the 1st (Writes the date on the board). | | |
| | 00:50 | 12. (The children are distracted by someone at the door). | | |
| 01:07 | | 13. T: Ok. Today we are doing something new. Today we will talk about numbers: positive numbers, negative numbers and what the negative is. We will talk about numbers only. One group is positive and the other group is negative. We will see what the difference between them is. Listen well. (Goes to the board). Ok. (Draws a number line and puts 0 in the centre). Do you see? Where is it? The zero is in the centre. | | |
| | | 14. Some children repeat: In the centre, in the centre. | | |
| 02:02 | 01:54 | 15. T: Ok. Why? Because on this side (Points at right side of the number line), I want to have positive numbers | T: Why? Because this side né, I want to have positive numbers né and then this side, I want to have negative numbers, né. And then we talk | |

| | | | | |
|---|---|---|---|---|
| | | and this side (refers to left side of the number line), I want negative numbers. Now we'll talk about the difference between the numbers. (Writes + above the number line). This is positive, positive, positive. Do you know it? | about the difference between numbers, né. Okay. |  |
| | 02:26 | 16. Ll, Ly, Lv: Positive, positive. | | |
| | 02:28 | 17. Lb: (To Lv) I don't understand this. | | |
| 02:35 | | 18. T: (Writes -). This is negative, negative, negative. | | The number line consists of zero in the centre. |
| | 02:30 | 19. Ll, Ln, Lz: negative, negative. | | |
| 02:40 | 02:34 | 20. (They are again distracted by someone at the door). | T: Now this side I'm going to have positive numbers and this side I'm going to have negative numbers né. And look at the difference, which number is big and which number is small, okay. Here we got positive one, né. Here we got positive two, né. Here we got positive three. Here I've got positive four. Here I've got positive five né. Then this side I've got negative one né, negative two, negative three, negative four, negative five, né. | |
| 03:06 | | 21. T: Now, this side (refers to right side of number line) we have positive numbers and this side (refers to left side of number line) we have negative numbers. We will look at the difference. Which number is big and which number is small. Do you hear? (Writes on the number line: +1, +2, +3, +4, +5). Then this side (Writes -1, -2, -3, -4, -5 on number line). | |  |
| 04:04 | | 22. T: Now, all the numbers that have positive… All the numbers that have positive are big numbers. (Points at positive numbers). | T: Now, now all the numbers that have positive né …all the numbers that have positive are big numbers, né. | The right side of the number line is positive, the left side is negative. |
| | 04:03 | 23. Ll: It's big. | | |
| 04:25 | | 24. T: All these (points at positive numbers) are big. Which means they are greater than zero. *[All positive numbers are big and greater than zero]*. All the numbers that have positive are greater than zero. Do you hear? I'm saying all… you (refers to Ln) all the numbers that are positive, positive, positive say what? It's bigger than who[11]? Zero. Do you hear? All the positive numbers are what? Positive, positive, positive. Meaning it's bigger than what? Zero. Do you hear? | T: These numbers here né are big really which means they are greater than u-zero, né. All the numbers that have positive né are greater than zero. Uyeva? *(Do you hear?)* Zonke, zonke Nangamso né *(All of them, all of them, Nangamso*). Zonke inamba's positive, positive, positive. *(All the numbers are positive, positive, positive).* Zitheni zinkulu *(Why are they bigger?)*. Kunabani? *(Than who?)* Kuno-zero *(Than zero)*. Siyavana? *(Do you understand?)* Zonke inamba's kunabani? (*All the numbers are who?*) Positive, positive, positive. Zitheni zinkulu kunabani? (*They are bigger than who?)* Kunozero *(Than zero*). Siyavana? Siyavana? Siyavana? (*Do you understand? Do you understand? Do you understand?)* |  |
| | 04:54 | 25. Ln, Lz, Lv, Lu: Bigger than zero. | | Positive numbers are to the right of zero and negative numbers are to the left of zero. |
| 05:19 | | 26. T: Good. (Points at left side). These numbers are small. They are below zero. All the numbers that have a negative, negative sign are less than and below zero. All the numbers that have negative are small and less than zero. All the numbers that are negative, are small and below what? Zero. | T: These numbers zona *(they)* are less, less than less than u-zero (*zero*). All the numbers né that have a negative, negative sign are less than zero. Zonke inambas ezitheni? *(All the numbers are what?)* Ezino ezino negative, negative ezitheni? Zincinci kunabani? (*All the numbers that are negative are smaller than who?)* Kunozero *(Than zero).* Né? Siyavana? (*Do you understand?*) Zonke inambas ezitheni negative, negative, negative zitheni? Zincinci kunabani? (*All the numbers that are negative, negative, negative are smaller than who?)* Kunozero *(Than zero).* | |
| 05:26 | 05:47 | 27. Lv, Lz, Ln: (Imitate teacher's signing). | | |
| 06:09 | | 28. T: All the numbers that are positive mean what? | T: Zonke inambas ezi positive, positive sithe zitheni kanene? *(All the* | |

[11] The teacher signs "who" instead of "what" when referring to objects

| | | | | |
|---|---|---|---|---|
| | | | *numbers that are positive what did we say?)* | |
| | 05:56 | 29. Lz: Zero. | | |
| | 05:56 | 30. Lv: Zero, one. | | |
| | 05:56 | 31. Ll: It’s big. | | |
| | 05:57 | 32. Lz, Ln: It’s big. | | |
| 06:17 | 05:58 | 33. T: Yes, it’s big, it’s big. Ok. Good. | T: Big! Yes, big, u-zero (*zero*). Okay. | |

**<u>Criteria</u>:**

- There are two groups of numbers: positive numbers and negative numbers
- The numbers can be found on a number line.
- Zero is positioned at the centre of the number line. Zero is not part of the teacher’s subsets of negative and positive numbers.
- Positive and negative numbers are spatially arranged to the right and left of zero respectively on the number line.
- Positive numbers are big and negative numbers are small. Big and small therefore functions as synonyms for positive and negative with reference to numbers.
- A positive number is a number that has a plus sign preceding it.
- Positive numbers are greater than zero.
- Numbers to the left of zero are small.
- Numbers that have a negative sign preceding them are less than and below zero.

- With reference to the topic *integers*, the following criteria map out the existential features of numbers:
- There exists two groups of numbers, called positive numbers and negative numbers.
- Positive numbers have a plus sign (+) preceding them; negative numbers have a minus sign (-) preceding them.
- The numbers can be arranged by means of number line, having zero in the centre, with negative numbers to the left of zero and positive numbers to the right of zero.
- Zero is not a member of the group of negative numbers, nor is it a member of the group of positive numbers.
- A positive number has the global quality of being big; a negative number, of being small.
- A positive number is greater than zero; a negative number, less than zero, and is below zero.

## Evaluative Event 2: Ordering integers using worked examples

### Evaluative Event 2.1: Representing ordering using the inequality symbols

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 06:22 | | 34. T: Now we'll talk about big, small, big, small, big, small Do you know this sign? (Writes >) Do you know it? [Teacher has the expectation that the learners are familiar with the symbol]. | T: Now, now talk about big small né, big small né, big small né. Do you know this sign? | |
| | 06:18 | 35. Lb: I know. It's a mouth. | | |
| 06:39 | | 36. T: What does it mean? What does it mean? (points at >) | T: Mean what? | |
| | 06:22 | 37. Lv: It's a mouth. | | |
| | 06:23 | 38. Lz: It's a bird's beak. | | |
| | 06:23 | 39. Lb: Three is less, fourteen is big. I remember it from Rose's class. | | |
| | 06:24 | 40. Lz: It's a bird's beak. | | |
| 06:54 | 06:30 | 41. T: You say it's a mouth? What do you (Lu) say? | | |
| | 06:41 | 42. Lu: (Full response not recorded). It's a little bird's mouth. I don't know. | | |
| 07:03 | | 43. T: Ok, ok (smiling). If the mouth is open, we say it's big. If the other one is closed, it's small. Ok. (Writes<).Do you know this? | T: Ok, Ok, ok. I'm learning another thing. If … uthi *(he says)*… it's big. If that side… zithini *(it says)*… Ok. You also know this one? Né? You know this one? |  |
| | 07:08 | 44. Lv: If it's open, it's big. | | |
| | 07:10 | 45. Lz: The mouth is open. | | |
| | 07:10 | 46. Lu: I know it; I know it from Teacher Rose. | | |
| | 07:11 | 47. Lb: I know it from teacher Rose. | | Teacher writes the symbols on the board without numbers. |
| 07:31 | | 48. T: Ok. Good. | | |

**Criteria:**

- The symbols have some relation to the terms *big* and *small*. The teacher does not clarify the relationship between the symbols and the terms *big* and *small*, however her previous criteria suggested that big and small were synonymous with positive and negative numbers.
- The symbols can be compared to a mouth which can open and close. This criterion is derived from the learners' representations and has no mathematical foundation.
- "If the mouth is open, *it's* big" is ambiguous as it is not clear what the word *it's* is referring to as there are no numbers accompanying the symbols.
- "If the other one is closed, it's small" is also ambiguous as there are no numbers accompanying the symbols.

**Comments:**

The teacher does not indicate that the inequality signs do not represent big or small independently of numbers. Instead they are relational symbols which are used to demonstrate comparisons between two numbers. The choice of the sign (“less than” or “more than”) is dependent on the order in which the numbers are written and the example 5>2 is the same as 2<5.

### Evaluative Event 2.2: Two positive integers: $+5$ and $+3$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| O7:34 | | 49. T: Now we will talk about big and small, big and small. [Teacher seems to be referring to positive and negative numbers]. Now I want to know something from you. If now, I have (Writes +5 and +3). Which number is big? | T: Ok, ok. Now we talk about big, small, big, small, né? Now, I want to know something from you. If, if now I’ve got positive five then here I’ve got positive three. Which number is big? |  The teacher indicates the objects which are two positive integers. |
| | 07:40 | 50. Ll: On the left, positive. | | |
| | 07:40 | 51. Lv: Five. | | |
| | 07:40 | 52. Lb: On the left, five. | | |
| | 07:40 | 53. Lz: On the left, on the left. [Learners point at the number on the left rather than say positive five]. | | |
| | 07:41 | 54. Ln: Positive, positive [The learners are able to order to whole numbers]. | | |
| 08:00 | | 55. T: Which one? | T: Which one? | |
| | 07:42 | 56. Lb: Which one? Positive. | | |
| | 07:43 | 57. Lz, Lv: Five. | Lz: Five | |
| | 07:43 | 58. Ln, Lu, Ln: Positive. | | |
| | 07:44 | 59. Ll: Positive…five. | Ll: Five | |
| 08:04 | | 60. T: Five means what? [Teacher’s question is ambiguous]. | T: Five uthini? *(Five says what?)* | |
| | 07:46 | 61. Ll: Positive. | | |
| | 07:46 | 62. Ln, Lb: Positive. | | |
| 08:06 | 07:47 | 63. Lz: It’s big. | | |
| 08:06 | | 64. T: Choose which one. Choose which one from here (points at the board). [Teacher seems to be encouraging the learners to continue guessing]. | T: Inkulu. Chooza eyiphi? Chooza eyiphi? Ezi two. *(It’s big. Choose which one? Choose which one? From these two).* | |
| 08:09 | 07:51 | 65. Lz: Five on the left. | | |
| 08:10 | 07:51 | 66. Lv: On the left. | | |
| | 07:52 | 67. Lb: Five on the right, no on the left. | | |
| | 07:55 | 68. Lu: Left. Positive. | | |
| | 07:53 | 69. Ln: On the left. On the right (looks at the other children). It’s on the left. | | |
| 08:13 | | 70. T: Which one? Show which one is big. | T: Eyiphi? Ubona? *(Which one? Do you see?).* Show big… | |
| | 07:57 | 71. (Children point to the numbers on the board). | | |
| 08:20 | | T: (Writes on the board). Choose which one. [Teacher | T: Okay, let’s say one here … Chooza *(choose)* which one? Which one? | |

| | | | | |
|---|---|---|---|---|
| | | wants the learners to choose the symbol without providing the criteria for representing the ordering]. | | |
| 08:26 | 08:05 | 72. Lz: One. | |  |
| 08:26 | 08:06 | 73. Lv: Two. | | |
| | 08:07 | 74. Ln: One. | | |
| | 08:05 | 75. Lb: On the right. Two. [Learners guess as they have a limited number of options]. | | Teacher has labelled the inequality signs as (1) and (2) |
| 08:27 | | 76. T: One. We said… (Writes >). It that right? Is that right? [Teacher asks learners' to confirm the answer which encourages them to continue guessing]. | T: One. Ok. Say… Right? Right? Right? | |
| | 08:13 | 77. Lb: It's wrong. | |  |
| | 08:16 | 78. Ll: It's right. | | |
| 08:35 | | 79. T: She said five is bigger than three. [Teacher implicitly clarifies the representation of the ordering]. Do you agree? (Looks at Ly). Is it right, is it right? Is it true? | T: Uthi *(she says)* five is bigger than three, né. Uyavuma? *(Do you agree?*) Uyavuma, Yongama? *(Do you agree, Yongama?)* I-right Yongama? (*Is it right, Yongama?)* It's fine? Nyani, nyani, nyani u-right? (*Is it true, is it true? Is she right?)* U-wrong? *(Is she wrong?)* Uthini wena? *(What do you say?)* | Teacher fills in the inequality symbol |
| 08:48 | 08:29 | 80. Ll: It's right. | | |
| | 08:33 | 81. Ly: It's big. | | |
| 08:55 | | 82. T: Really? He says positive three is big. | T: Hmm? Uthi u-positive three u-big. *(He says positive three is big).* | |
| | 08:40 | 83. Lz: No, five is big. | | |
| 09:02 | | 84. T: Yes. It's true, true, true what she is saying. It stands for five is big. [*Teacher does not use relational terms to compare the numbers*]. | T: Ewe, uthi yena nyani, nyani, nyani yena umile five is big. *(She says it's true, true, true. It stands for five is big)* | |
| | 08:45 | 85. Lb: I don't understand, I don't understand. [*Teacher's criteria are inadequate*]. | | |
| | 08:44 | 86. Lu: It's true. I know she's right. | | |
| 09:08 | | 87. T: What do you say (to Ll)? Is she right? | T: Wena uthini? U-right? *(What do you say? Is she right?)* | |
| | 08:51 | 88. Ll: Five is right. | | |
| 09:11 | | 89. T: You right. What do you say? Is she right? | T: Right. Wena uthini? U-right? *(You, what do you say? Is she right?)* | |
| 09:12 | 08:53 | 90. Lb: I forgot. | | |
| 09:13 | | 91. T: Don't say you don't know. You must think. [Teacher expects the learners to know how to order the numbers based on their knowledge of whole numbers]. | T: Hayi, cinga. Sukuthi awazi *(No, think. Don't say you don't know)*…Think. | |
| | 08:58 | 92. Lb: (Doesn't respond). | | |
| 09:18 | | 93. T: Is it right? Is it true, true, true five is big? | T: Is that right? Nyani, nyani, nyani, nyani? *(Is it true, true, true?)* Five it's big? | |
| 09:23 | 09:04 | 94. Lb: Five is big…I don't know. [*Learner does not know how to order whole numbers*]. | | |
| 09:25 | | 95. T: (To Ly) And you? What do you say? | T: Ok. Uthini wena? *(You, what do you say?)* | |
| 09:28 | 09:10 | 96. Ly: Five is big. Five is big. | | |
| 09:30 | | 97. T: Five is big. And you? (To Lv) | T: Hmm? Five big? | |
| | 09:14 | 98. Lv: Yes she was right. She's right. | | |
| 09:34 | | 99. T: You right (to Lv). (To Ln). What do you say? | T: Nangamso, uthini wena? *(Nangamso, what do you say?)* | |

| | | | | |
|---|---|---|---|---|
| | 09:19 | 100.Ln: She's right. | | |
| 09:39 | | 101.T: You right. You (To Lu). | T: Right. | |
| | 09:21 | 102.Lu: Five, five is bigger than three. | | |
| 09:42 | | 103.T: Good. Remember, she said, if the number, if the number is bigger, the mouth is big. The small part faces the small number. Ok. (Points at +5>+3). This is right. | E: Okay. Remember? Okay, let's remember né. She said if the number, if the number it's big né, the mouth, it's… and then that small part né faces the small number né? Ok. This one it's right né. We are moving, right. | |

**<u>Criteria for ordering two positive numbers- +5 and +3</u>:**

- One number is big. The teacher's criterion that positive numbers are big collapses as both numbers are positive. She expects the learners to recognise the order of the numbers based on their knowledge of whole numbers. The teacher does not explain that numbers within the set of positive numbers can be compared to each other. She does not use relational terms such as *greater than* or *less than* to compare the numbers.

**<u>Criteria for representing the order of the numbers using inequality symbols</u>:**

- The open part of the symbol faces the big number.
- The closed part faces the small number.

### Evaluative Event 2.3: A positive and negative integer: $-4$ and $+2$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 10:11 | | 104.T: (Writes on the board). | |  |
| | 10:13 | 105.Lz: Four. | | |
| | 10:14 | 106.Ln: On the left, four. | | |
| | 10:13 | 107.Lu: Negative, negative. | | |
| 10:33 | | 108.T: Now I want to know, I want you to remember, remember what we said about all the numbers that have a positive. Remember? Don't forget… *[Teacher refers to criterion that positive numbers are big].* | T: Now, I want to know… Now I want… remember, remember what we said about all the numbers that have a positive. Remember, né? Don't forget. | The teacher indicates that the objects are a positive and negative integer. |
| | 10:28 | 109.Lb: I forgot, I forgot. | | |
| 10:47 | | 110.T: … what we said about all the numbers that have a positive sign. | T: …what we said about all the numbers that have a positive sign. | |
| | 10:35 | 111.Lb: I forgot | | |
| 10:54 | | 112.T: Now. (Points at the board). Negative four and positive two. Now, I want you to choose which number is big. *[The learners are told to "choose" which encourages them to guess rather than think about the answer mathematically].* | T: Now. Here I've got negative four and positive two. Now, I want you to choose, choose which number is big? | |
| | 10:49 | 113.Lz, Ln: Four. | | |
| 11:10 | | 114.T: Which number is big now? | T: Which number is big now? | |
| | 10:52 | 115.Lb: Two. | | |

| | | | | |
|---|---|---|---|---|
| | 10:52 | 116.Lv, Ln, Lz: Four *[The signs are excluded from the learners' responses].* | | |
| | 10:56 | 117.Lb: Six *[This learner seems to be adding 4 and 2 as whole numbers].* | | |
| 11:13 | | 118.T: Some say four, others say… Look there are two numbers (points at the board). I want to know which number is big. *[Teacher does not correct the responses as being positive or negative integers].* | T: The others say it's four, the others they say it's… no we got two numbers. Now I want to know which number it's big? | |
| | 11:03 | 119.Ln: Four. | | |
| | 11:03 | 120.Lz: Two. | | |
| 11:24 | | 121.T: She said it's number four. What do you say? (to Lb). *[Teacher accepts 4 as a response].* | T: Ok. Uthi yena *(she says)* it's number four. Wena *(you)* number who? | |
| | 11:08 | 122.Lb: Two. | | |
| | 11:09 | 123.Lz: Six. | | |
| 11:28 | 11:11 | 124.T: You say positive two is big. And you? | T: You said positive two it's big. | |
| 11:33 | 11:14 | 125.Ll: Negative four is smaller. | | |
| 11:36 | | 126.T: Who? | T: Who? Who? | |
| 11:37 | 11:18 | 127.Ll: Four is big [*Learners changes his answer in response to teacher's question*]. | | |
| 11:37 | 11:18 | Lb: You choose, choose | | |
| 11:38 | | 128.T: Four, four is big? You (points at Lv)? | T: Four, four big? Ok. | |
| 11:40 | 11:22 | 129.Lv: Four is big. Four. | | |
| 11:43 | | 130.T: Four is big. You (points at Lz)? | T: Four big. | |
| 11:43 | 11:24 | 131.Lz: Four is big. | | |
| | | 132.T: And you? (To Ln) | | |
| | 11:26 | 133.Ln: Four is bigger. | | |
| | | 134.T: You? | | |
| | 11:28 | 135.Lu: It's big. *[Learners have not acquired the criterion that positive numbers are big].* | | |
| 11:50 | | 136.T: Ok, remember we said, we said. All the numbers that have a positive are big. Remember, we said all the numbers that have a positive are big. We said all the numbers that have a negative are small. Now, I want to know which number is big (points at the numbers on the board). Which number is big? | T: Okay, remember what we said here. We said all the numbers that have a positive are big. Remember? We said all the numbers that have a positive sign are big. And then we said all the numbers that have a negative sign are small. Now I want to know which number is big here? Between the two? Which number is big? Hmmm? Which number is big? | |
| 12:22 | 12:02 | 137.Lv: (Points at the board). Four. *[Learner has not acquired the criteria. He responds with a whole number].* | | |
| 12:29 | 12:09 | 138.Lz, Ll: Two. | | |
| | 12:11 | 139.Lb: Two. | | |
| 12:29 | | 140.T: Two. Two. And you? | T: Two. Two. | |
| | | 141.Ly: *(Response not recorded).* | | |
| 12:33 | | 142.T: You are copying him. It's true, true, true. | T: Two. | |

| | | | | |
|---|---|---|---|---|
| 12:38 | | 143.Ly: Two. | | |
| 12:39 | 12:19 | 144.*(Children are distracted by someone at the door.)* | | |
| 12:44 | | 145.T: And you? What do you say? | | |
| | 12:24 | 146.Lv: Four. | | |
| 12:45 | | 147.T: And you? | | |
| | 12:26 | 148.Lz: Two, two. | | |
| 12:47 | | 149.T: Two. And you? | | |
| | 12:28 | 150.Ln: Four. | | |
| 12:48 | | 151.T: Four. And you? | | |
| 12:49 | | 152.Lu: Two. Two is smaller. | | |
| 12:51 | | 153.T: Two is smaller. Again. (Walks to the board). All the numbers that have positive are? Small or big? | T: Again. All the numbers that have that have a positive, a positive are? Ncinci *(small)*, big? | |
| | 12:46 | 154.Ln: Big. | | |
| 13:05 | | 155.T: If a number has a positive is it big or small? | T: If number have a positive, is it big or small? | |
| 13:08 | 12:50 | 156.Lz: It's big, big, big. | | |
| 13:12 | | 157.T: Big. Now why do you say four is bigger? Why? But you have a negative four. Why do say so? | T: Big. Now, why, you said four, four it's big why? But we have a negative four. Why you said so? Hmmm? | |
| | 13:04 | 158.Lb: It's big. | | |
| 13:29 | | 159.T: Again. I'll say it for the last time. Remember, I said here (Points at the number line) | T: Again, again. For the last time. Remember what we said here, né? Remember what we said? We said… | |
| | 13:17 | 160.Ll: Positive is big. | | |
| 13:36 | | 161.T: Positive, positive, positive is big. Negative, negative, negative is small. | T: Ya, positive, positive, positive, positive, positive big, né? Negative, negative, negative, negative small né. | |
| | 13:24 | 162.Ll: Negative is small. | | |
| 13:46 | | 163.T: Now which one is big? | T: Now, which number, which number here is big? | |
| 13:50 | 13:31 | 164.Lz: Two. | | |
| 13:51 | | 165.T: Two, two. Which one (Points at <, >). Which one? You there (To Ly) Which one do you choose? (Points at < and >). Which one do you choose? | T: Two, two. Chooza… *(Choose)* Chooza eyiphi? *(Choose which one?)* | |
| 14:03 | 13:43 | 166.Lb: (To Ly). You must choose. | | |
| | 13:43 | 167.Ly: Positive, positive two. | | |
| 14:04 | | 168.T: One or two *[Refers to symbols which were previously labelled as 1 and 2. The labelling is confusing as the numeral two is also in the example].* | T: One, two? Chooza Eyiphi? *(Choose which one?)* |  Teacher refers to symbols previously written on the board. |
| 14:05 | | 169.Ll: Two. | | |
| 14:05 | | 170.Lb: One. | | |
| 14:08 | 13:48 | 171.Lv: Two. | | |
| 14:09 | 13:50 | 172.Lz: Two. | | |
| 14:09 | | 173.T: Choose which one. | T: Chooza eyiphi? *(Choose which one?)* | |
| | 13:52 | 174.Ll, Lv, Lz, Ln: Two. | | |
| 14:12 | | 175.T: What do you choose? What do you choose? You choose two. And you? (To Ly). | T: Chooza you? Chooza two? *(You choose? Choose two?)* | |
| | 13:56 | 176.Ly: (*Response not recorded*). | | |

| | | | | |
|---|---|---|---|---|
| 14:18 | | 177.T: Hey you! You? (To Lv). | | |
| | 13:58 | 178.Lv: Two. | | |
| 14:19 | | 179.T: And you? | | |
| | 13:59 | 180.Lz: Two. | | |
| | 14:00 | 181.Ln: Two *[Most learners respond with the < symbol].* | | |
| 14:24 | | 182.T: (Writes on the board-fills in inequality sign). Which means that four is small. *[Teacher refers to integers as whole numbers].* It's negative, negative. Don't forget about positive and negative. Because these are important (Points at + and – on the board). They are important. *[The signs preceding the numbers are important].* Because if you say four, two. Yes! (Writes on the board). Which number is big here? | T: So, which means here né four ncinci *(small)* negative, negative. Let's not forget about positive, negative because important are these signs. These signs are important, né? Because if you said four, two. Yes, here. If we write it like this. So which number is big there? | <br>Teacher fills in the inequality sign. |
| | 14:37 | 183.Lz: Two…? The big one? | | |
| 14:58 | | 184.T: Yes. | | |
| | 14:40 | 185.Lz: Four. | | |
| | 14:41 | 186.Ll: Four is smaller *[Learner cannot order whole numbers. May be copying teacher who previously indicated that four is small].* | | <br>Teacher illustrates the importance of the signs by removing them and considering the numbers as whole numbers. The above example contradicts her criterion that positive numbers are big. |
| 15:00 | | 187.T: Yes, it's four, four. Because (writes + above 4 and 2). Every time you see the "i" (Fingerspelling) *[Teacher uses the letter 'i' to refer to the term integers. The term was never signed or explained to the learners prior to this]*, look at the sign. Is it positive or negative? Don't just look where. Where? These (points at positive and negative signs) are very important. They are important. Now, positive two is big and negative four is small. | T: Four, four. Because this is positive, positive né? So every time né when you look at the integers, look at the sign, sign. Is it positive? Is it negative né? Don't just look. Nje *(Just))*. Sukujonga nje *(Don't just look)*. I-Important kakhulu *(It's very important)* Lena nalena né. *(This one and this one)*. This and this are important né. So now positive two, it's big né. Negative four, it's small né? Again, sigqibile *(we're done).* | |

**Criteria with reference to ordering a positive and negative integer:**

- Numbers preceded by a positive sign are big. Positive is synonymous with big.
- Numbers preceded by a negative sign are small. Negative is synonymous with small.
- The signs preceding the numbers are important when determining the greater number. The positive number will always be greater than the negative number.
- Positive numbers are big. This criterion collapses when she presents the example of 4 and 2 which are both positive numbers. The teacher does not explain that positive numbers can be compared to each other. She states that the entire set of positive numbers is big which creates ambiguity as she expects the learners to be able to compare two positive numbers.

**Criteria for representation of the order:**

- The expression -4<+2 indicates that negative four is smaller than +2. The teacher does not explain that the notation +2>-4 means the same as -4<+2.

## Evaluative Event 2.4: Two negative integers: −7 and -2

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 15:43 | | 188. T: Again, for the last time. (Writes on the board). Which one is big and which one is small? Which one is big and which one is small? Which one? | |  |
| | 15:40 | 189. Lz: Seven… two, two. | Lz: Two | The teacher indicates the objects on the board. The objects are two negative integers: -7 and -2 |
| | 15:42 | 190. Ll: Seven is smaller. | | |
| 16:04 | | 191. T: We are saying. These (Points at the numbers) is it small or big? | | |
| | 15:50 | 192. Lb, Lv: Seven. | | |
| | 15:50 | 193. Lu: Seven is small. | | |
| | 15:52 | 194. Ll: Seven is smaller. | | |
| | 15:53 | 195. Ly: Seven *[Learners respond with whole numbers].* | | |
| 16:11 | | 196. T: You are saying... Which one is smaller? | | |
| 16:12 | | | Ly: Seven, seven, seven | |
| 16:15 | 15:56 | 197. Lv, Lb: Seven. | | |
| 16:16 | | 198. Ll: Seven is small. | | |
| | | 199. T: (To Ll): You saying seven is smaller. Don't forget, don't forget. Positive, positive, positive is important. Negative or positive is important. | | |
| 16:24 | 16:04 | 200. Ll: Positive is important. | | |
| 16:24 | | 201. T: (To Ly): Which one is small, which one is big? You. | | |
| 16:29 | 16:07 | 202. Ly: Seven. | | |
| 16:30 | | 203. T: Which one? | | |
| 16:32 | 16:09 | 204. Ly: Seven, negative, negative. | | |
| 16:32 | | 205. T: Is it small or big? | | |
| | 16:14 | 206. Ly: It's small. | | |
| 16:34 | | 207. T: He says negative, negative seven is small. Ok. What do you say? (To Lz). | | |
| | 16:22 | 208. Lz: Seven… two is bigger. | | |
| 16:42 | 16:22 | 209. Lv: Seven is bigger, seven is bigger. | | |
| | 16:23 | 210. Ln: Seven is bigger *[Learners seem to consider -7 and -2 as whole numbers]* | | |
| 16:47 | | 211. T: You? (looks at Ln). | | |
| | 16:30 | 212. Ln: Seven is bigger. | | |
| | 16:31 | 213. Lz: She says seven is bigger. | | |
| 16:51 | | 214. T: (Points at -7 and -2). Choose which one is small and which one is big. | | |
| 16:56 | 16:37 | 215. Lz: Seven is big. Seven. | | |
| | 16:37 | 216. Lb: Two is small. Seven… | | |
| 16:58 | | 217. T: She says seven is bigger. What do you say? (To Lu). | | |

| | | | | |
|---|---|---|---|---|
| | | 218. Lu: (*Response not recorded*). | | |
| 17:03 | | 219. T: She says two is small and seven is big. What do you say (To Ln)? | | |
| | 16:50 | 220. Ln: Seven is big (seems unsure). | | |
| 17:13 | | 221. T: Is seven big? What do you say? Is it big or small? | | |
| | 16:54 | 222. Ln: seven is big, small. | | |
| 17:18 | | 223. T: Big or small. Big? Speak, speak! Don't be afraid. | T: Hayi, kaloku *(No)*. Uthi wena uthi inkulu, inkulu *(You say it's big, it's big).* Kodwa *(But …)*. Thetha, thetha, thetha *(Speak, speak, speak).* Sukoyika (*Don't be scared)*. | |
| | 17:03 | 224. Lb: Is it big or small? | | |
| | 17:07 | 225. Ln: It's big, seven. | Ln: Inkulu *(It's big).* | |
| 17:26 | | 226. T: which one is big? | T: Ngowuphi omkhulu? *(Which one is big?)* | |
| | 17:08 | | Ln: Seven. | |
| 17:28 | | 227. T: Seven what? Two. I'm saying, wait, listen. Please, please, if you leave out maybe the positive or maybe the negative you are wrong. It's important to look at the number and the sign [*Teacher considers integer as a numeral with a sign preceding it*]. Look at the number and at the sign. Now, we say we don't have seven. What comes before seven? Before, before? Who is this? (Points at -). | T: Seven mkhulu *(seven is big).* Uthi *(she says…)* Ndithe mamela *(I said, listen)*, ndithe *(I said)* né please, please if uyayishiya, uyayishiya né *(you leave it, you leave it)* maybe positive, maybe negative, uzakubhuda né *(you will make a mistake).* Ku-important *(it is important)* look at the number and a sign né? Look at the number, number and the sign. Here, we don't have seven. Before, before u-seven kukho ntoni? *(What is there?)* Ngubani lo, before, before u-seven? *(Who is before seven?)* Ngubani? Ngubani lo? *(Who? Who is this?)* | |
| | 17:47 | 228. Lb: It's big, it's big. Before seven is negative, negative. | | |
| 18:10 | 17:50 | 229. Lz: Two. | | |
| 18:12 | | 230. T: This (Points at 7). All of it? | T: Le idibene yonke? *(Together, all of it).* | |
| | 17:54 | 231. Ll: Negative seven is bigger. | | |
| 18:14 | | 232. T: All of you. It's negative, negative seven. And this is negative two (points at -2). | T: Le *(this)* it's negative, negative seven né. Lena *(this one)* it's negative two. Né? | |
| | 18:02 | 233. Ln: Negative two. | | |
| | 18:03 | 234. Lz, Ll: Two. | | |
| 18:25 | | 235. T: This is negative seven (Points at -7) and this is negative two (points at -2). Okay? | T: This one is negative seven, né? This one is negative two né. Siyavana? *(Do you understand?)* | |
| | 18:12 | 236. Lb: It's negative two. | | |
| | 18:18 | 237. (Some learners nod). | | |
| 18:39 | | 238. T: Look at this (Points at 0 on number line). This (Points at 0 and 1). It's opening. This (points at 0). It's closed. From zero to positive one, it opens a little. Now, to go from positive one to positive two, it opens a little. Now, to go again from there to positive three, it opens. From zero to positive four, it opens. It opens and gets wider and wider. From zero to all positive numbers. [*Teacher seems to be referring to inequality sign which opens wider and wider*]. | T: Here, let's go here, né. We said here this one né, this is zero né? This is zero né? When we move from here to here né it's a little bit bigger. If, here… né? It's like this. Then when we move from zero to positive one, it's opening like this né? Now, you are moving from positive one né to positive two. It's opening like this né? And then now we are moving again from, from zero to positive three. Opening like this né? From zero to positive four like this, you see. It goes from here…like this, like this and this. From zero to all positive numbers. |  Teacher refers to number line previously drawn on the board. |
| 20:01 | | 239. T: Now, we come to this side (Points from 0 to left side | T: Then coming from this side, né, né? Now, remember here zero né? | |

| | | | | |
|---|---|---|---|---|
| | | of number line). Now, remember this (points at 0) is zero. This (Points at -1) is big *[Contradicts previous criterion that negative numbers are small]*. This (Points at 0). From here (Points at 0) to here (Points at place after +5) it's closed then it opens wider, wider and wider till it's open and big. Now, from here (Points at 0) to here (Points at -5). From zero, it's big! Zero is big. (Points at 0 then -1) it's big. Then it gets smaller and smaller. (Points at 0 then -2), it gets smaller. (Points at 0 then -3), it gets even smaller. (Points at 0 then -4), it's even smaller. (Points at 0 then -5), it gets very small. This means negative one is very big! *[Contradicts previous criterion that negative numbers are small. It is implicit that numbers within the group of negative numbers are being compared to each other].* This (Points at -1) is very big. This (Points at -5) gets small. This (Points at -1) is big. This (Points at -5) is small *[Does not refer to the numbers in comparative terms]*. This (Points at +1) is small and this (Points at +5) is big. Do you see? From zero to negative one, it gets bigger. From zero to positive one, it gets smaller. Ok? (Points from 0 to +5) it's big! Ok? [*Teacher generates criteria that numbers are increasing. Simultaneously she states that inequality sign is getting narrower*]. | This one, it's big, né? Here from here to here né? Then open, open, open, open, open né? Then from here from here to here né? It's zero, né big! Né? This zero it's big. And then from here to here, it's big né like this and then we are moving so né? From here to here né? From here to here we are moving like this. From here to here né. From here to here né. Which means né negative one its big né. This is big né? This, its small né? This one, big. This one, small. This one small. This one, big. You see, né? From here to here, big, né? From here to here…né, né? Then here to here big, né, né? | |
| 22:00 | | 240. T: Now, I want to know which number is big between negative seven and negative two? Which number is big between the two? Negative seven and negative two? Which number is big? (Points at both numbers). | T: So now, what I want to know, which number it's big between negative seven and negative two? Which number it's big? Between, between the two? Between negative seven and negative two, which number it's big? Here and here. Which one is big? | |
| 22:24 | 22:05 | 241. Lz: Seven. | | |
| | 22:09 | 242. Ll: Seven is small…big. | | |
| 22:29 | 22:10 | 243. Lv: Two. | | |
| | 22:12 | 244. Lu: Two. | | |
| 22:29 | | 245. T: Which number is big between these (Points at -7 and -2). | T: Which number is big between this and this? Which one is big? | |
| | 22:16 | 246. Lu: Two. | | |
| | 22:20 | 247. Lz: Seven. | | |
| 22:35 | 22:20 | 248. Lv: Two. | | |
| | 22:20 | 249. Ln: Two. | | |
| 22:38 | | 250. T: (Looks at Ll). Is it big? | T: Hmm? Seven big? Huh? | |
| | 22:21 | 251. Ll: Seven is big. | | |
| | 22:21 | 252. Ln: Two is big. | | |
| | 22:23 | 253. Lz: Seven is big. | | |
| | 22:22 | 254. Lv: Two *[Learners responses indicate that they have* | | |

| | | | | |
|---|---|---|---|---|
| | | *not acquired the criteria regarding the number line].* | | |
| 22:41 | | 255. T: Remember, I said from (Points at 0 and 1) is what? | T: Remember we said here from here to here, it's? | |
| | 22:28 | 256. Ll: Big. | | |
| | 22:28 | 257. Lz: Small, big. | | |
| | 22:28 | 258. Lv: Nought, it's small. | | |
| | 22:28 | 259. Lb: Nought, big *[Learners seem confused].* | | |
| 22:47 | | 260. T: No. What? You! (Points at Ll). It's big. | T: Uh, uh. It's big like this, né? | |
| | 22:33 | 261. Lz, Lu, Ll: it's big. | | |
| 22:53 | 22:37 | 262. T: From here (Points at 0) to here (Points at -5) what is it? | T: From here to here it's … | |
| | | 263. Ll, Lz: It's small. | T: So now, which number now it's big between negative seven and negative two? Which one is big? Who? | |
| 22:57 | | 264. T: That's it. Yes. Now, which number is big between negative seven and negative two. Which is big? Who, who, who? | | |
| | 22:48<br>22:51 | 265. Ll: Seven is small, seven is small *[Whole number response].* | | |
| | 22:52 | 266. Lb: Small, small. | T: Okay! Good! Good. Negative seven, it's ncinci *(small)* né? Negative two it's big. | |
| | | 267. Lz: Two. | | |
| 23:10 | | 268. T: That's it (Refers to Ll). Good. He's right *[Teacher accepts a whole number as the correct response]*. Negative seven is small. Negative two is big *[Teacher produces the required solution]*. | T: He's right, né. Negative seven it's… Now, chooza *(choose)* which one? |  |
| | 23:02 | 269. Ln, Lz, Ll: It's big. | | |
| 23:24 | | 270. T: He's right (Refers to Ll). It's small. Now, which one do you choose? (Points at > and <). | | Learners are selecting the symbols based on the numbers written above the symbols. |
| | 23:15 | 271. Lb: Two. | | |
| | 23:17 | 272. Ln: Two. | | |
| | 23:18 | 273. Ll: Two on the right *[Learners are selecting based on the labels previously given to the symbols].* | T: Number, number, number? | |
| 23:37 | | 274. T: Two? Is that true? Number? Number? Number? | | |
| | 23:22 | 275. Lu: Number. | T: Which one? Which one? | |
| | 23:23 | 276. Ln: Two. | | |
| 23:43 | | 277. T: Choose which one? | T: Chooza *(choose)* now between the two. One and two… Which one? | |
| | | 278. *(Children do not respond).* | | |
| 23:46 | | 279. T: Choose now between one and two. Which one is it (Points at < and >). | | |
| | 23:29 | 280. Lu: Two. | |  |
| | 23:32 | 281. Ln, Lz: Two. | | |
| | 23:35 | 282. Lz: One. | | |
| | 23:36 | 283. Ll, Lu, Ln: Two *[Most learners select the correct symbol indicating that they have acquired the criteria for representing the ordering].* | | Teacher fills in the inequality sign between the integers. |
| 23:57 | | 284. T: It's two. Yes! (Writes < on the board). Do you see? | T: Two, yes! This né, remember. Luhle *(child's name)*, where are you | |

| | | | | |
|---|---|---|---|---|
| | | Remember… (Tries to get Lu's attention). | now? | |
| | 23:51 | 285. Lu: I'm sorry. | | |
| 24:11 | | 286. T: Are you here now? | | |
| | 23:52 | 287. Lu: He's teasing me (points at Ly). | | |
| 24:15 | | 288. T: (Calls Ly). This is a class. Nangamso, leave that now. | T: Yongama, Yongama. No. This is a class. | |
| | 24:09 | 289. (*An announcement is made on the intercom*) | | |
| | 24:10 | 290. Ll: You must be alert and sign. | | |
| 24:30 | | 291. T: Look at me. You are right. Remember, she said -7 is small (Points at the closed side of the < sign). It's small. (Points at -2). It's open wide. | T: Remember, Luhle said né negative seven is ncinci *(small)*…this… | |
| | 24:27 | 292. (Learners repeat: Open wide) | | |
| 24:48 | | 293. T: (Points at the closed side of <). It's small. | T: Né? | |
| | 24:31 | 294. (Learners repeat: It's small) | | |
| 24:51 | | 295. T: (Points at -2). It's big. | T: Né? | |
| | 24:33 | 296. (Learners repeat: it's big). | | |
| 24:54 | | 297. T: Good. (Draws a line below -7<-2 and erases +4 and +2). | | |

**Criteria with reference to ordering two negative integers:**

- One number is big, the other number is small. The teacher is comparing two negative numbers' however her previous criterion was that all negative numbers are small. She now restates the criteria by saying that one number is big and the other is small. The negative or positive sign preceding the number is important. The teacher reiterates this criterion as the learners are responding with whole numbers rather than integers.
- It is important to consider the number and the positive or negative sign.

**Criteria with reference to the number line:**

- From zero and to the right of the number line, the inequality sign opens wider and wider. The teacher seems to use *opening wider* to refer to the inequality signs. She previously compared the inequality sign to a mouth which opens.
- When comparing zero to the numbers to the left of it, zero is big.
- From zero to the left of the number line, the inequality sign becomes narrower. She adds the criteria that within the group of negative numbers, numbers are bigger and smaller. It is implicit that the numbers can be compared to each other.
- Negative one is big and negative five is small. The teacher does not state that the numbers are bigger or smaller when compared to each other or other numbers. It is implicit that she is comparing the numbers in terms of size.
- Positive one is small and positive five is big. It is implicit that she is comparing these numbers to each other.
- From zero to positive one, the inequality sign opens.
- From zero to negative one, the inequality sign closes (becomes narrower).

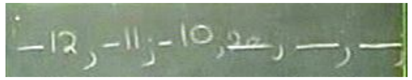
- From zero to positive five the numbers are big. She restates that positive numbers are big.

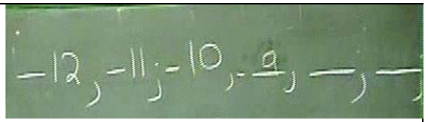
**<u>Criteria with reference to representing the ordering:</u>**

- The closed side of the symbol faces the small number.
- The open side faces the big number.

### Evaluative Event 3: Ordering sequences of integers through three worked examples

### Evaluative Event 3.1: Example 1: $-12$, $-11$, $-10$, _, _, _

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 25:11 | | 298. T: Now, I want you to help me finish the numbers. (Writes on the board). What is this? Finish, finish? | T: Good. Okay. Now né, I want you to help me finish, finish the numbers, né? Here I've got… |  The teacher has written a sequence of integers on the board. |
| 25:47 | 25:23 | 299. Lb: I know. (Raises his hand). It's nine. [A whole number]. | | |
| 25:53 | | 300. T: (Gives her chalk to Ly). Go up. Go and write. Go up. | T: Write. Go. | |
| 25:58 | | 301. Ly: (Gets up and goes to the board). | | |
| 26:08 | | 302. T: Write there. | | |
| | 25:49 | 303. Ly: (Writes 20). I don't know. (Goes back to his seat). *[Learner does not produce the required response].* | |  Learner has filled in 20 following -10 in the sequence. |
| 26:16 | 25:58 | 304. *(An announcement is made on the intercom)* | | |
| 26:18 | | 305. T: Is he right? | | |
| | 25:59 | 306. Learners: He is wrong, wrong. | | |
| 26:22 | | 307. T: (To Ly): You are not listening, you are not listening. You are just doing your own thing. You are doing anything. Think. If (erases his answer from the board). Here we go from negative twelve to (Points at 11) negative eleven, (Points at -10) negative ten. (Points at the line next to -10) What number comes here? After, after ten? *[Teacher is relying on the learners' knowledge of counting backwards in whole numbers].* | T: Sukwenza nje apha (*Don't just do anything here)*. Sukwenza nje *(Don't just do anything)*. Cinga (*Think*). If… here né we are moving from negative twelve, here it's negative eleven, here it's negative ten. And then here, what number? After, after ten? | |
| | 26:38 | 308. Lz: Nine *[Whole number response].* | | |
| 26:59 | | 309. T: Wait, wait. What is the number that comes before, before ten? What number comes before ten? *[Teacher uses whole numbers instead of integers].* | T: Just wait. The number, the number before, before siyofika ngu-ten *(we get ten)*. Ngubani inamba ebefore u-ten? *(What is the number before ten?)* | |
| | 26:57 | 310. Ly: (*Response not recorded*). | | |
| 27:11 | | 311. T: Why did you write twenty? Write it on the board. | T: Why you go and write twenty? Go and write it. What is right? | |
| | 27:06 | 312. Ly: (Gets up and goes to the board). | | |

| | | | | |
|---|---|---|---|---|
| 27:19 | 27:11 | 313.T: (To Ly): you must think, think. You are playing here. | T: You need to think, you need to think. Don't just play here. |  Learner's response is nine following from negative ten. |
| 27:26 | | 314.Ly: (Writes 9 on the board). | | |
| 27:28 | | 315.T: (Gets his attention). What's the same thing you see? Here (points at -12) negative twelve, here (points at -11) negative eleven, here (points at -10) negative ten. What is that (Points at 9)? What sign is there? *[Teacher indicates that the learner has omitted the sign].* | T: What's the same, same, same thing? Here we write negative twelve, negative eleven, negative ten. And then, what number is that? What sign is there? | |
| 27:50 | 27:30 | 316.Ly: (Points at the second line drawn by the teacher). | | |
| 27:52 | 27:33 | 317.T: (Redraws a line under 9 and points at it). | T: What sign is here? Which sign? | |
| 27:57 | | 318.Ly: Nine. | | |
| 27:57 | 27:37 | 319.T: Yes, nine is right *[The teacher accepts a whole number response].* But with which sign? *[The number has a sign that goes with it].* All the numbers have, have something. Before, before, before the number there is something. What did you leave behind? What did you leave behind? | T: Yes, nine is right but with the sign? All these numbers have, have something. Before, before, before, before the number ikhona into *(there is something)*. Ngubani omshiyileyo? *(Who did you leave behind?)* Ushiye bani? *(Who did you leave behind?)* | |
| 28:19 | | 320.Ly*: (Cannot see response)* | | |
| 28:20 | | 321.T: What? Look here (points at - sign of -12). What is this? What is it? Twelve what? (Again points at -12). What is it? Is it just that? | T: Hmm? Apha *(here)*… Yeva? *(Do you hear?)* Unantoni? *(What does it have?)* U-twelve unantoni? *(What does twelve have?)* Yintoni le? *(What is this?)* Yinto nje, nje? *(Is it just, just that?)* | |
| 28:36 | | 322.Ly: (*Cannot see response).* | | |
| 28:37 | | 323.T: There it is. What is this (points -11)? | T: Ngoku, ngubani lo? *(Now, who is this?)* | |
| 28:41 | | 324.Ly: (*Cannot see response*). | | |
| 28:43 | | 325.T: (Points at -10). | T: Ngubani lo? *(Who is this?)* | |
| 28:43 | | 326.Ly: (*Cannot see response*). | | |
| 28:44 | | 327.T: And here (points at 9)? | T: Apha? *(Here).* | |
| 28:45 | | 328.Ly: (*Cannot see response*). | | |
| 28:46 | | 329.T: What is it? What is it? | T: Unantoni? *(What does it have?)* Unantoni? *(What does it have?)* | |
| 28:52 | | 330.Ly: (*Cannot see response).* | | |
| 28:53 | | 331.T: Look, (Points at – of -12). | T: Yongama, ngubani lo? *(Yongama, who is this?)* | |
| 28:55 | | 332.Ly: Negative, negative. | | |
| 28:57 | | 333.T: What is this whole thing (points at -12)? What is all of this? What do you say? Negative what? | T: Yonke le nto ngubani? *(All this, who is it?)* Yonke le nto? (*All of these?)* Sukuthi *(Don't say)* …Ngubani? *(Who is it?)* | |
| 29:02 | | 334.Ly: Twelve, twelve. | | |
| 29:03 | | 335.T: Ok, what's this? (Points at -11). | T: Heke *(yes).* | |
| 29:04 | | 336.Ly: Eleven, eleven. | | |
| 29:05 | | 337.T: (Looks upset). | | |
| 29:06 | | 338.Ly: negative, negative, negative eleven. | | |
| 29:08 | | 339.T: Ok, what is this? (Points at -10). | T: Heke *(yes).* | |
| 29:10 | | 340.Ly: Negative, negative ten | | |
| 29:13 | | 341.T: What is this? (Points at __ after -10) | T: Here? | |
| 29:16 | | 342.Ly: Negative… | | |
| 29:17 | | 343.T: (Gives the chalk to Ly). Write. | T: That's it… write. | |

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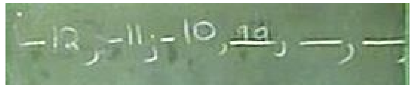
|---|---|---|---|---|
| | 29:03 | | Ll: Bhala *(write)* | |
| | 29:03 | 344.Lu: I know it. | | |
| | 29:04 | 345.Lz: There's no negative, there's no negative. | | |
| 29:26 | | 346.Ly: Negative, negative (seems unsure). | | |
| 29:31 | | 347.T: Write it. | T: Bhala, Yongama *(Write, Yongama).* | |
| 29:32 | | 348.Ly: (Just looks at the board). | | |
| 29:38 | | 349.T: What is this? (Points at -12). | T: Yongama, ngubani lo? *(Yongama, who is this?)* | |
| 29:42 | | 350.Ly: (*Cannot see response*). | | |
| 29:43 | | 351.T: No. | | |
| 29:44 | | 352.Ly: (*cannot see response*). | | |
| 29:45 | | 353.T: Yes, what is this (Points at -11)? | T: Ya, Ikhona *(Yes, it's there)*. Ngubani lo? *(Who is it?)* | |
| 29:46 | | 354.*Ly: (Cannot see response).* | | |
| 29:48 | | 355.T: Yes, what is this? (Points at -10). | T: Heke, ngubani lo? *(Yes, who is this?)* | |
| 29:49 | | 356.Ly: (*Cannot see response*). | | |
| 29:54 | | 357.T: Yes, what is this (Points at __ next to -10). | T: Heke *(yes).* Apha, ifaneluba ngubani? *(Here, what is it supposed to be?)* | |
| 29:56 | | 358.Ly: (*Cannot see response*). | | |
| | 29:35 | 359.Lz: (Tries to get Lu's attention). He wants to fight now he doesn't understand. | | |
| 29:57 | | 360.T: Write it there. | T: Bhala kaloku *(write).* | |
| | 29:39 | | Ll: Bhala *(Write).* | |
| 30:00 | | 361.Ly: (Writes 9 in front of the previous 9). | | |
| 30:02 | | 362.T: Again. (She erases 9 and points at the 9 written previously). There is something there you are forgetting. There is something. | T: Again. Nanku u-nine. Nanku u-nine. Ikhona le nto uyishiyileyo. Ikhona, ikhona. *(Here is nine. Here is nine. There's something you left out. There is, there is).* |  |
| | 29:46 | 363.Lu (To classmates): I know, I know. It is negative. | | |
| 30:09 | | 364.T: Think and write it there. You must write it there. What is this? (Points at -12). | T: Yicinge (*Think of it).* Uzakuyibhala, Yongama *(You are going to write it, Yongama).* Uzakuyibhala ngokwakho. *(You will write it yourself)* Ngubani lo, Yongama? (*Who is this, Yongama?)* | Learner writes another 9 in front of the previous 9. |
| | 29:53 | 365.Lz to Lb: It's negative. That's all. | | |
| | 29:54 | 366.Lu to Lv: He's not writing negative there**.** | | |
| 30:14 | | 367.Ly: Negative twelve. | | |
| 30:17 | | 368.T: What is this? (Points at -11). | T: Heke, ngubani lo? *(Yes, who is this?)* | |
| 30:18 | | 369.Ly: Negative eleven. | | |
| | 29:58 | 370.Lv to Lz: Yes, there's nothing there. | | |
| 30:19 | | 371.T: What is this? (Points at -10). | T: Heke, bani lo? *(Yes, who is this?)* | |
| 30:21 | | 372.Ly: Negative ten. | | |
| 30:23 | | 373.T: What's this? (Points at 9). | T: Heke, apha? *(Yes, here?)* | |
| | 30:02 | 374.Lz to Lv: It's negative nine | | |
| 30:25 | | 375.Ly: Negative nine. | | |
| 30:27 | | 376.T: Yes, write it. | T: Bhala *(write)* | |
| 30:30 | | 377.Ly: (Looks at the board and does not write anything) | | |
| 30:35 | | 378.T: Come here (To Ly). (Points at -12). What is this? | T: You see, she said it but she can't write it. Yongama, yiza *(Yongama,* | |

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|---|---|---|---|---|
| | | | *come)*. Ngubani lo? *(Who is this?)* | |
| | 30:17 | 379.Lz: Negative, negative, negative. | | |
| 30:48 | | 380.Ly: Negative twelve. | | |
| 30:49 | | 381.T: This? (Points at -11). | T: Heke *(yes).* | |
| 30:50 | | 382.Ly: Negative eleven. | | |
| 30:51 | | 383.T: What's this? (Points at -10). | T: Heke *(yes).* | |
| 30:51 | | 384.Ly: Negative ten. | | |
| 30:54 | | 385.T: This? (Points at 9). | T: Apha? *(Here?)* | |
| 30:55 | | 386.Ly: Negative eight (seems unsure) . | | |
| 30:58 | 30:39 | 387.T: What? Again, again? | T: Huh? Again, again. | |
| 31:02 | | 388.Ly: Negative… | | |
| 31:03 | 30:43 | 389.T: Now, what are you forgetting? What is it? What are you forgetting? There is something there that you are forgetting. | T: Heke *(yes)*. Now, ulibele ntoni apha? *(Now, what did you forget here?)* Ntoni, ntoni, ntoni oyilibeleyo? *(What, what, what have you forgotten?)* Ulibele ntoni? *(What did you forget?)* Ikhona into oyilibeleyo. *(There is something you have forgotten).* Yintoni? *(What is it?)* | |
| 31:11 | | 390.Ly: Nine. *[Learner is able to count backwards in whole numbers].* | | |
| 31:11 | 30:53 | 391.T: This (Points at nine) it's there, I agree. Nine is there. What are you forgetting? What are you forgetting? *[Teacher accepts nine as a response but the sign is missing].* | T: Nanku, nanku u-nine ukhona. Ndiyavuma, ndiyavuma *(Here, here is nine. I agree, I agree.* U-nine ukhona, walibala ntoni *(There is nine, what have you forgotten?)* Ulibele ntoni? *(What did you forget?)* | |
| | 31:03 | 392.Ly: (Does not respond and looks at classmates) | | |
| 31:23 | 31:04 | 393.T: Before, before nine there is something you are forgetting. What is it? | T: Before, before u-nine ikhona into oyilibeleyo *(Before nine there is something you have forgotten)*. Yintoni? *(What is it?)* Hmm? | |
| 31:30 | 31:10 | 394.Ly: (Does not respond) | | |
| 31:33 | 31:14 | 395.T: But when you speak, you say it. You don't want to write it. What are you forgetting before nine? | T: But xa uthetha uyayixela *(But when you speaking, you mention it)* Awufuni kuyibhala. *(You don't want to write it).* Ulibele ntoni before u-nine? *(What did you forget before nine?)* | |
| 31:43 | 31:23 | 396.Ly: (Does not respond). | | |
| 31:46 | 31:26 | 397.T: Lastly, lastly. What is this? (Points at -12). | T: Yongama, Yongama. Eyokugqibela ke ngoku (*The last one now).* Okokugqibela *(For the last time)*. Ngubani lo? *(Who is this?)* | |
| 31:51 | 31:32 | 398.Ly: Negative twelve. | | |
| 31:53 | 31:33 | 399.T: What is this? (Points at -11) | T: Ngubani lo? *(Who is this?)* | |
| 31:54 | 31:34 | 400.Ly: Negative eleven | | |
| 31:56 | 31:37 | 401.T: This? (Points at -10) | T: Ngubani lo? *(Who is this?)* | |
| 31:58 | 31:38 | 402.Ly: Negative ten | | |
| 32:00 | 31:40 | 403.T: This? (Points at 9). | T: Apha? *(Here?)* | |
| 32:00 | 31:40 | 404.Ly: Negative nine *[Learner signs desired response]* | | |
| 32:01 | 31:41 | 405.T: (Points at 9). What did you forget? | T: Ngoku ulibele ntoni apha? *(Now, what did you forget here?)* Ulibele ntoni? (*What did you forget?)* Hmm? | |
| | 31:44 | 406.Ly: (Does not respond). | | |
| 32:10 | 31:51 | 407.T: What did you forget? There is something very, very small you forgot. What did you forget? | T: Yintoni luyilibeleyo? *(What is it that you have forgotten?)* Ikhona into oyilibeleyo incinci, incinci, incinci *(It's something small, small, small that you have forgotten).* Uyilibeleyo yintoni? *(What have you forgotten?)* | |

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|---|---|---|---|---|
| 32:22 | | 408.Ly: I don't know. [*For this learner 9 is the same as -9*]. | | |
| 32:23 | 32:04 | 409.T: (Gives up). (Points at the other children) | T: Yho! Sawuhamba nexesha. *(We'll stick to the time).* Jonga *(look)*. | |
| | 32:07 | 410.Lz: Negative, negative, negative. | | |
| | 32:10 | 411.Lv: Negative, negative *[The other learners have realised what the missing element is].* | | |
| 32:30 | | 412.T: Negative, negative. You know it. You know, but you don't want to think. (To the other children) What did he forget? (Looks at Ln). What did he forget? | T: Yongama, subane-cheeky *(Don't be cheeky).* Uyayazi le nto *(You know this)*. Uyayazi but awufuni kucinga wena *(You know it but you don't want to think)*. Ulibele ntoni, Nangamso uYongama? *(What did Yongama forget, Nangamso?)* Yintoni le ayilibeleyo? *(What did he forget?)* | |
| | 32:32 | 413.Ln: Nineteen .*[Learner thinks 1 is missing from the answer as the other numbers have a one before it]* | Ln: Nineteen. | |
| 32:53 | | 414.T: (Looks upset). | T: Hayibo *(Oh no!)* | |
| | 32:34 | 415.Lz, Lv: Negative, negative. | | |
| 32:54 | | 416.T: He forgot negative, negative only. *[The learner's response was partially correct as only one element was missing].* | T: Ulibele negative, negative qha *(He forgot negative, negative, that's all).* | |
| | 32:40 | 417.Lv (to Ly): It's negative nine. | | |
| 33:01 | | 418.T: (To Lu). Go and write on the board. | T: Bhala *(write).* | |
| 33:04 | | 419.Lu: (Gets up and goes to the board) | | |
| 33:18 | | 420.T: What did Yongama forget? | | |
| 33:23 | | 421.Lu: Negative, negative, negative | | |
| 33:24 | | 422.T: Where must you write it? Where? Look there. Show him, show him. *[Learner is called up to fill in negative sign before 9].* | | |
| 33:26 | | 423.Lu (To Ly): You had to write negative there. | | |
| 33:28 | | 424.T: Write it there. Write it. | T: Bhala *(write).* |  Learner does not realise that the number following -10 is -9 and has written 1 following 9. |
| 33:32 | | 425.Lu: (Writes 1 following 9). | | |
| 33:39 | | 426.T: (Seems surprised). | | |
| | 33:19 | 427.Lv: That must be negative. | | |
| | 33:19 | 428.Lb: It's three, three. | | |
| | 33:22 | 429.Ll: Three, three. | | |
| | 33:22 | 430.Lz: I know it, I know it. | | |
| | 33:22 33:22 | 431.Lv: You both don't know there must be a negative there. | | |
| 33:48 | | 432.Ln: Negative, negative. | | |
| | | 433.T: (Erases Lu's answer). Who will help me? Who? | T: Ngubani ozakundihelpa mna? *(Who is going to help me?)* Ngubani, ngubani *(Who, who?)* | |
| | 33:32 | 434.Lz: (Raises her hand). | | |
| 33:51 | | 435.T: You (Points at Lz). | T: Come, help. | |
| 34:00 | 33:34 | 436.Lz: (Goes to the board). Negative… | | |
| 34:02 | | 437.T: Wait. Sit down (To Lu). | T: Yima *(Wait)*. Hlala, sisi, hlala *(sit down, sisi, sit down)*. | |
| 34:04 | | 438.Lz: It's negative here. (Fills in – preceding 9) | | |
| 34:08 | | 439.T (To Ly): Are you looking? Did you see the small thing | T: Ncinci *(small)*. Uyayibona ukuba incinci la nto ayilibeleyo? *(Do you see* | |

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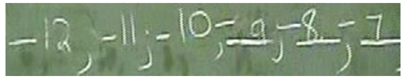
| | | you forgot? | *that it's a small thing you forgot?)* | |
| | 33:54 | 440.Ly: (Does not look at E). | | |
| 34:14 | | 441.T: Did you see? I said that you know it. (To Lz) continue. | T: Uyabona nditshilo that ikhona? *(Do you see I said that there's something)* | |
| 34:24 | | 442.Lz: (Writes -8) | | |
| 34:26 | | 443.T: Is it fine? | T: U-right? *(Is she right?)* | |
| | 34:08 | 444.Ln: It's fine. Yes. | | |
| 34:28 | | 445.T: (Tries to get Lb's attention). Sit over there. | T: Hlala *(sit).* | |
| | 34:13 | 446.Lb: (Goes to sit where T has indicated). | | |
| 34:49 | | 447.T: Is she correct? | T: U-right? *(Is she right?)* | |
| | 34:30 | 448.Ln: Yes. | | |
| | 34:31 | 449.Ll: It's right. | | |
| | 34:31 | 450.Lv: it's fine. | | |
| | 34:34 | 451.Ly: She's wrong, wrong. | | |
| 34:51 | | 452.T (To Lz): Continue. | | |
| 34:54 | | 453.Lz: (Writes -7) *[Learner seems to have acquired the criteria to complete the sequence].* | | |
| 34:56 | | 454.T: Is that correct? | T: U-right? *(Is she right?)* |  Learner completes the sequence on the board. |
| | 34:39 | 455.Ll, Ln: It's right. | | |
| | 34:40 | 456.Lv: It's right, right, right. | | |
| | 34:41 | 457.Ly: She's wrong, wrong. | | |
| 34:58 | | 458.T: (Applauds). Thank you. | | |
| | 34:47 | 459.Lz: (Returns to her table). | | |

**Criteria for sequencing integers using the example -12, -11, -10, _, _, _:**

- Count backwards in ones. The teacher relies on the learners' knowledge of counting backwards in whole numbers for them to complete the sequence.
- The numbers in the sequence have negative signs. The number following -10 should therefore also have a negative sign preceding it.



### Evaluative Event 3.2: Example 2: $\mathbf{2\ \ -2, -1, 0, \_, \_, \_}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 35:03 | | 460.T: (Writes on the board. She changes the + signs to - signs). | | |
| | 34:54 | 461.(Learners chat amongst themselves while she writes) | |  The teacher writes a sequence of integers on the board |
| 35:30 | | 462.T: What does it say? | T: Ithini leya? *(What does that one say?)* | |
| | 35:14 | 463.Ln: Negative two, negative two, negative two | | |
| | 35:22 | 464.Ll: Positive one, positive | | |
| 35:34 | | 465.T: Who? (Points at the line drawn next to 0). (Gives the chalk to Lb) | T: Ngubani apha? Ngubani? *(Who is here? Who?)* | |

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|---|---|---|---|---|
| 35:44 | 35:25 | 466.Lb: (Goes to the board. Looks at the problem). | | |
| 36:10 | | 467.T: (Tries to get the other children's attention). Wait, wait. Look at the board. | | |
| 36:17 | 35:36 | 468.Lb: (Tries to solve the problem) | | |
| | 35:30 | 469.(Learners chat amongst themselves). | | |
| 36:35 | | 470.Lb: I don't know. | | |
| 36:38 | | 471.T: Are you happy you know it? (To the other learners) | T: Hmm? Ndiyavuya ukhona oyaziyo *(I'm glad there is someone who knows it)* | |
| | 36:22 | 472.Ll: I know it. | | |
| 36:42 | | 473.T (To Ll): Wait, wait. (Looks sternly at Ly). Help me (To Lv). Go to the board. | T: Vuyiswa, helpa *(help)*. Go help. | |
| 36:57 | 36:37 | 474.Lv: (Gets up and goes to the board. She writes 1 after 0). | | |
| 37:13 | | 475.E: What, what? One? One is correct. One what? Just one? Is it free, free, free? One what? Who is one married to? *[Teacher accepts one as correct but states that there is an element missing from the answer. She equates the relationship between the number and the sign to a marriage].* | T: Unantoni? Unantoni la-one? *(What does it have? What does that one have?)* Ewe *(yes)*, good. U-one unantoni? *(What does one have?)* Nje? *(Just?)* U-free, u-free, u-free, u-free *(Is it free, free, free?)*. Utshata ngubani la one? *(Who is one married to?)* Utshate nabani? *(It's married to who?)* Huh? | |
| 37:28 | 37:07 | 476.Lz: Ten…nine…eight. | | |
| | 37:08 | 477.Ln: Negative two. | | |
| 37:28 | | 478.Lb: Positive two. | | |
| 37:28 | | 479.T: She is right. Look at her. She is correct (Points at Lv then points at 1 on the board). From 0 to… | T: Lo Vuyiswa u-right *(This Vuyiswa is right)*. Apha from ze… *(Here from…)* | |
| 37:34 | | 480.Ll: It's positive one. | | |
| 37:37 | | 481.T: Look at him (Refers to Ll). | | |
| 37:38 | | 482.Ll: Positive one *[Learner may be looking at the number line].* | | |
| 37:41 | | 483.T: Do you see that? | T: Hmmm? Uyayibona? *(Do you see that?)* | |
| 37:44 | | 484.Ll: Positive one. | | |
| 37:46 | | 485.T: Did you hear what he said? Write it there (Points at the board). | T: Uyayiva? *(Do you hear?)* Uva uthini *(Do you hear what he's saying?)* Bhala…*(Write).* |  |
| 37:52 | | 486.Lv: (to T) Is it positive one? | | |
| 37:53 | | 487.T: You (Points at Ll). Again, go up. | T: Again xelela *(tell)*, Leonardo. | Learner has produced the correct response. |
| 37:58 | 37:38 | 488.Ll: (Goes to the board and writes +1, then +2). | | |
| 38:04 | | 489.T: (Tries to stop him but he has already continued). Ok, finish it. Continue… | T: Huh uh, sukubhala *(stop writing)*, okay…okay finish, finish. | |
| 38:13 | 37:53 | 490.Ll: This? (Points at line after +2). Is it negative? | | |
| 38:16 | | 491.T: I don't know. | | |
| 38:18 | 37:58 | 492.Ll: (Writes +3). | | |
| 38:19 | 38:00 | 493.T: (Applauds). Good. Thank you. (To Lb): Do you see? Do you see? I told you to look but your eyes were closed. | T: Thank you, thank you. Bayalibala *(They forget)*. Ya, ya uyayibona *(Do you see?)* Heke. Xelela, xelela *(yes, tell, tell)* Finish. Uyijongile but awuboni uyimfama ukhona *(You looked at it but you didn't see it because* | |

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| 38:36 | | 494.Lb: I was looking | *you are blind)*. Nantso ke *(there it is)*. Okay. | |

**Criteria for sequencing the integers:**

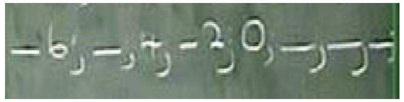
- Teacher does not provide the criteria but expects the learners to rely on their knowledge of counting whole numbers to produce the desired responses. She has also left the number line on the board. The learners may be reproducing the numbers on the number line.

**Existential features of integers:**

- The numbers and signs are "married".



### Evaluative Event 3.3 Example: 3: $-6, \_, 4, -2, 0, \_, \_, \_$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 38:44 | | 495.T: Lastly… (Writes on board). | T: Yeyokugqibela le *(this is the last one)*. |  The teacher does not realise that she has written the sequence incorrectly on the board. The way it has been written creates confusion as it is not clear whether the lines indicate missing numbers or whether they are negative signs. |
| | 38:37 | 496.(*The bell rings indicating the end of the first period*) | | |
| 38:56 | | 497.T: Lastly. Who? Who? Who will help? | T: Uyayifuna ngoku? *(Do you want it now?)* | |
| 39:08 | | 498.Lu: (Raises her hand). It's two. | | |
| 39:19 | | 499.T: (Hands the chalk to Lu). | | |
| 39:21 | | 500.Lu: I know I'm right. (Fills in 2 following 0). | | |
| 39:23 | | 501.T: Is that all? | T: Nje? *(Just?)* | |
| 39:33 | 39:14 | 502.Lz: She is wrong! | | |
| | 39:14 | 503.Ly: Negative, negative, negative *[This learner is aware that a sign is missing from the answer].* | | |
| 39:38 | | 504.T: Where is the positive or negative? | | |
| 39:39 | | 505.Lu: It's positive. | | |
| 39:40 | | 506.T: Where is it? Why did you leave it out? | | |
| 39:41 | | 507.Lu: (Writes +2). *[Learner seems to have understood the order of sequence].* | | |
| 39:43 | | 508.T: Thank you, thank you. (Applauds). Who else? | | |
| | 39:29 | 509.Lz: (Raises her hand). | | |
| 39:48 | | 510.T: Wait, I want someone else. (Hands the chalk to Ln). | | |
| 40:03 | | 511.Ln: (Fills in +3 following +2). | | |
| 40:06 | | 512.T: Is she right? | T: Hmmm? Hmmm? Right? | |
| 40:06 | | | Ly: Hayi, hayi *(no, no).* | |
| | 39:50 | 513.Lu: She is wrong. | | |
| 40:09 | | 514.T: (Points at -6). This is negative six. | T: Hayi, hayi *(no, no)*. Remember apha *(here)*… minus six. | |
| | 39:56 | 515.Lz: Minus, minus, minus. | | |
| 40:16 | | 516.T: Minus six. Who is here? (Points at space between 4 and -6). Who is between these? (Points at space to be | T: Ok. Minus six, né? Ngubani apha? *(Who is here?)* Apha bani? *(Here, who?)* | |

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| 40:25 | | filled in). | | |
| 40:26 | 40:06 | 517.Ll: There is no positive, leave the positive. | T: Ushiye le bani? *(Who is left out?)* Apha, apha? *(Here, here?)* | |
| | | 518.T: Leave who? Who is between these (points at -6 and 4)? (Points at -6) Who is this? *[Teacher indicates that* | | |
| 40:34 | | *there is a number missing between -6 and 4].* | | |
| | 40:14 | 519.Lz: Six. | | |
| | 40:14 | 520.Lu: It's six. | | |
| 40:34 | 40:14 | 521.Ll: Five *[Learner's response could be correct as the teacher has written the sequence incorrectly].* | | |
| 40:34 | | 522.T: Who is this? (Points at line next to -6). | | |
| 40:36 | 40:17 | 523.Ll: It's five. | | |
| 40:38 | | 524.T: Next (Points at 4). *[Teacher accepts five as a* | | |
| 40:38 | | *response].* | | |
| | 40:20 | 525.Ll, Lv: Four. | | |
| | 40:19 | 526.Lz: Five…four. | | |
| 40:41 | | 527.T: And this? (Points at -2). | | |
| 40:42 | 40:23 | 528.Ll, Lv: Three *[These learners seem to think the teacher is referring to an omitted number between 4 and 2]* | | |
| | 40:23 | 529.Lz: Five. | | |
| 40:43 | | 530.T: Next. | | |
| 40:44 | 40:26 | 531.Ll, Lv: Two. | Ly: Zero, zero. | |
| 40:46 | | 532.T: And this? (Points at zero). | | |
| 40:47 | 40:27 | 533.Lz, Lv, Ll: Zero. | | |
| 40:48 | | 534.T: (Points at +2). | | |
| 40:49 | 40:30 | 535.Lv, Ll, Lz: Two. | | |
| 40:50 | | 536.T: Who is before, before two? *[Teacher is referring to the positive sign].* | | |
| | 40:34 | 537.Ll: Three. | | |
| | 40:35 | 538.Lv: Six. | | |
| 40:55 | | 539.T: Before… (Points at positive sign). | | |
| | 40:39 | 540.Lb: Positive one, positive one. | | |
| 40:57 | | 541.T: Before, before this. (Looks at Lb) Yes, you right. Now how many? | | |
| | 40:45 | 542.Lb: Positive… | | |
| | 40:46 | 543.Lu: Zero…two. It's two. | | |
| 41:06 | | 544.T: It's two, two, two, two. *[Teacher implicitly indicates that the numbers are increasing by two].* Good. (Erases +3 written by Ln). What is it? What is it? You said two, you were right (To Lu). It's two, two, two. What is it? | T: …Good. | |
| | 41:01 | 545.Lz: Positive, positive, positive. | | |
| | 41:03 | 546.Lv: Two, two, two. | | |
| 41:23 | | 547.T: What is it? | | |
| | 41:08 | 548.Lv: Positive two, positive two. | | |

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|---|---|---|---|---|
| 41:30 | 41:10 | 549.Lz: One, two… positive two, positive two. | | |
| 41:32 | | 550.Lu: Two, positive, two, two, two. | | |
| 41:34 | | 551.T: (Shakes her head). | | |
| 41:41 | | 552.Lz: (Raises her hand). It's positive four *[Learner may be guessing as +1 and +3 were incorrect].* | | |
| 41:43 | | 553.T: (To Lz) Go up to the board. | | |
| 41:44 | | 554.Lz: (Goes up to the board and writes +4 after +2). | | |
| 41:56 | | 555.T: Yes (Applauds). | | |
| | 41:39 | 556.Ln, Lu: (Applaud). | | |
| 42:00 | 41:43 | 557.T: (Gives the chalk to Ly). Go up. | |  |
| 42:14 | | 558.Ly: (Stands in front of the chalkboard and seems unsure. He writes +5 after +4). *[Learner may be confused because sequence is written incorrectly on the board].* | | The sequence is completed by a few learners rather than one learner. The learners call out answers until the correct response is produced. |
| 42:49 | | 559.Lv: It's six *[Learner may have guessed as five was incorrect].* | | |
| 42:51 | | 560.Ly: (To Lv) You know it. You know it. (Returns to his seat). | | |
| 42:56 | | 561.T: (Erases Ly's response from the board). | T: Vuyiswa. | |
| 42:58 | 42:40 | 562.Lv: It's six. | | |
| 42:58 | | 563.T: You, come up (To Lv). | | |
| 43:08 | | 564.Lv: (Writes +6 after +4). | | |
| 43:11 | | 565.T: Good. Thank you, thank you. | | |
| | 42:51 | 566.Lz: (Claps her hands). | | |

**Criteria regarding sequencing integers:**

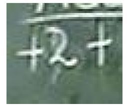
- The number should be accompanied by a positive or negative sign
- There are numbers between the integers written in the sequence which have been left out, i.e. between -6 and -4. The semi-colon written between four and the negative sign is ambiguous. The negative sign could be mistaken for a line where an integer needs to be filled in.

**Comments:**

The teacher does not provide criteria for completing the sequence. She relies on the learners' knowledge of counting whole numbers. The learners may also be using the number line which is drawn on the board. She implicitly suggests that the numbers are increasing by two. The fact that the sequence is written incorrectly creates confusion. The learners seem to guess until the teacher accepts the correct response.

## Evaluative Event 4: Addition of integers through four worked examples

### Evaluative Event 4.1: Two positive integers: $+2 + +4 = +6$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 43:15 | | 567. T: Now, we will continue. We will talk about plus, plus, plus. [The teacher indicates the operation which is addition]. (Writes on the board). | T: Now, siya move(a) *(We are moving)*. Siza kwenza addition, addition, addition, addition *(We are going to do addition, addition, addition)*. |   The teacher has indicated the operation on the board. She has written the term *integers*, however has not introduced this term to the learners in her signing. She has not provided a definition of the term. |
| 43:36 | | 568. T: Now, maybe I want to borrow R2.00 from Lb. Who is Lb lending the money to? Nomhle. *[Teacher uses a word problem to generate the objects which are two positive integers].* | T: Now, mna, mna *(me, me)* né maybe ndiboleke iR2 *(Maybe I borrow R2 ku…)*. Sithi né uBabalo, uBabalo uboleke bani? *(We say, we say Babalo lent it to who?)* Ku-Nomhle *(To Nomhle).* | |
| | 43:40 | 569. Ll: To Nomhle. | | |
| 44:00 | | 570. T: How much money is he lending? Two rand. | T: Wamboleka malini? *(He lent how much money?)* i- Two Rand, two rand né. | |
| 44:02 | 43:43 | 571. Lz: Two Rand. | | |
| | 43:43 | 572. Ln: Two rand. | | |
| 44:06 | | 573. T: (Writes on board). *[The R2.00 is the positive integer].* | T: Ndiboleke i-Two Rand *(I borrowed two Rand)* |   Teacher writes the borrowed R2.00 as a positive integer (+2). She writes the operation next to it. |
| | 43:45 | 574. Ly: Two rand. | | |
| 44:15 | | 575. T: (Points at the word "Addition"). You know this addition is plus, plus, plus. (Writes + above the word). Addition is plus, plus, plus, plus. *[Teacher confirms the operation and clarifies what the written word "Addition" refers to].* Now, remember Lb borrowed to who? | T: Lena mos siyamazi u-addition ngulo plus, plus, plus. *(This, we know addition is plus, plus, plus)*. u-Addition means plus, plus, plus. Now, remember, uBabalo uboleke bani? *(Babalo lent money to who?)* | |
| | 44:13 | 576. Lz, Ln, Lv: Two rand. | | |
| 44:32 | | 577. T: To Nomhle. How much money? | T: Ku-Nomhle *(To Nomhle).* Yimalini? *(How much money?)* | |
| 44:34 | 44:15 | 578. Lz, Ln, Lv: Two rand. | | |
| 44:34 | | 579. T: Two Rand. Again, I'm hungry but there's no money. (To Lb): Be quiet and listen. I'm hungry but I'm poor, poor, poor. How much did I borrow from him? | T: Two Rand né. Mna *(me)*, again. Mlamba (incorrect) kukhona *(there is hunger)*, imali ayikho né *(there is no money)*… mamela *(listen)*. Mna again jonga mlamba ukhona né *(me again, look there is hunger)*. Mna poor, poor, poor ikhona *(I am poor)*. Yena ebeboleke how much? *(He loaned how much?)* | |
| 44:59 | 44:39 | 580. Lv: Two rand. | | |
| 44:59 | | 581. T: Two Rand. Again, I go to him (Lb) and say please, please can I borrow another what? Two, four… Now, maybe I want to buy vetkoek and a cooldrink. I go to him again. Who do I go to? Babalo. I say "Please, please again can I borrow R4?" | T: Two Rand. Again, mna ndiyahambe ndiye kuye *(I go to him again)*. Ndithi *(I say)* please, please again, again mandiboleke enye yintoni? *(I must borrow another what?)* I, i-four. Now, maybe ndifuna uthenga igwinya and i-drink né *(Now maybe I want to buy vetkoek and a drink).* Ndiphinde ndihambe ndiye kubani? *(Again, who must I go to?)* Ku-Babalo *(To Babalo)*. Ndithi please, please…again…again boleka mna again i-four Rand. *(I say please, please … again… again lend me four Rand).* | |
| | 45:09 | 582. Lz: You will have six Rand. *[This learner is able to do the whole number calculation].* | | |
| 45:36 | | 583. T: (Writes on the board). Now, how much is all, all the | T: Now, aphinda uBabalo andiboleke… *(Again Babalo lends me…)* Mna | |

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|---|---|---|---|---|
| | | money I borrowed from Babalo? | ke ngoku iyonke iyonke imali endibolekwe nguBabalo, yimalini? *(Now, how much money altogether do I have that I loaned from Babalo?)* |  |
| | 45:33 | 584. Lv: Four. | | |
| 45:50 | | 585. T: All of it? Remember, before I borrowed R2. Finished. Again, I borrowed R4. Finished. How much is it altogether? | T: Iyonke *(Altogether)*. Remember, before ndiboleke i-Two Rand *(Remember, before I borrowed R2)*. Finish. Again mandiboleke i-four Rand *(Again, I must borrow R4)*. Finish. Iyonke *(Altogether)* how much? | Teacher adds positive four to positive two. |
| 46:02 | 45:43 | 586. Lb: Six Rand, six Rand. | | |
| 46:02 | | 587. Lz: Six rand, six rand. *[These learners are able to do the whole number calculation].* | | |
| 46:03 | 45:45 | 588. T: (To Lb) Good, that's right. Yes, yes. Altogether, it's six rand. (Writes on the board). I'm saying, positive 2 plus, plus positive 4. Altogether is who? Positive six. | T: Yonke *(Altogether)*. Ewe, ewe *(yes, yes)*. Yonke six rand né… *(Altogether six Rand).* Positive six. Apha ithi le *(Here it says)* positive two plus, plus né positive four. Yonke loo nto yenza bani? *(All of that makes how much).* Positive six né. Uyayibona? *(Do you see it?)* |  |
| 46:35 | | 589. T: (Points at +2). Positive. (Points at+4) Positive. Positive plus positive is what? Positive. | T: Positive…positive né. A positive plus a positive isinikabani? *(Gives us how much?)* Positive né. | The solution is positive six. |
| 46:48 | | 590. T: Now, how much is all the money of Babalo? Six Rand. | T: Now, mna *(me)*. Imali kaBabalo yonke how much? *(How much is Babalo's money altogether?)* It's six Rand né. | |
| | 46:35 | 591. Lz: Six rand. | | |

**Criteria for adding two positive integers:**

- Positive numbers are added as whole numbers.
- A positive number added to a positive number is a positive number.

### Evaluative Event 4.2: A positive and negative integer: $+6 + -2 = +4$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 46:58 | | 592. T: (Writes on board. Points at +6 on the board then continues writing). | T: Now, nantsi ke ngoku *(here it is now)*… Six Rand ka-Babalo.*(Babalo's six rand).* |  |
| | 46:52 | 593. Lz: Eight Rand [Learner seems to be adding 6 and 2 as whole numbers]. | | |
| 47:12 | | 594. T: Wait, wait (To Lz). Now, remember Nomhle borrowed six rand from Babalo. Now, there's money. I'm happy because the money is there. I go to him. I arrive and I pay R3. (Looks at the board).I pay R2. Remember, I borrowed six rand. I paid him two… (looks at Lb to get his attention) I paid him R2. Now, how much money is left that Nomhle owes Babalo? *[Teacher continues with a word problem].* | T: Yima, yima *(Wait, wait)*. Now, remember Nomhle uboleke i-six Rand kuBabalo *(Nomhle borrowed six Rand from Babalo).* Mna ke ngoku… mna ke ngoku (Me now, me now) Khumbula yena né ebendiboleke i-six Rand né *(Remember, he loaned me six Rand)*. Mna ndimbhatala… *(I paid)*. Mna né ndimbhatala i-two Rand *(I paid him R2)*. Now, ke ngoku imali eshiyekileyo kuBabalo noNomhle if … *(Now, how much money is left to Babalo and Nomhle if…?)* | The objects are a positive and negative integer |
| 48:07 | | 595. Lz: Four Rand *[This learner is able to do the whole number subtraction].* | | |

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|---|---|---|---|---|
| 48:08 | | 596.T: You right! Don't tell. Remember, if I… Remember, earlier I borrowed R6 from Babalo. Before, before, before Babalo loaned Nomhle R6. | T: If mna né, mna né *(me, me)*…Remember, before uBabalo ebendiboleke i-six Rand né *(Remember, before Babalo loaned me six Rand)* before, before, before uBabalo uboleke uNomhle i-six Rand *(Before, before he loaned Nomhle six Rand).* | |
| | 48:08 | 597.Ll: Six Rand. | | |
| 48:29 | | 598.T: Yes (To Ll). I saw that I had money so I went to him and gave him R2. How much money is left if I gave him R2? How much money is left? *[Teacher's language makes the operation seem like subtraction].* | T: Ya, mna ke ngoku imali ndibona ukuba imali ikhona *(Yes, now I see that there is money)*. Mna ndiyahambe, ndimnike i-two Rand né *(I went and gave him R2)*. Yimalini ekaBabalo eshiyeke kum if mna ndimnike i-two Rand? *(How much of Babalo's money is left if I gave him R2)?* | |
| 48:49 | 48:29 | 599.Lz: (Raises her hand). | Kushiyeke malini ngoku? *(How much money is left now?)* | |
| 48:49 | | 600.T: (To Lz) Don't tell. (To Ll): You. | | |
| 48:51 | 48:32 | 601.Ll: Two Rand. | | |
| 48:52 | 48:34 | 602.T: (To Ly): You. | T: Heke *(yes).* | |
| 48:53 | 48:35 | 603.Ly: Two Rand. | | |
| 48:55 | | 604.T: You (To Lv). | | |
| | 48:36 | 605.Lv: *(Response not clearly visible).* | | |
| 48:57 | | 606.T: (Returns to the board). Now, listen all of you. | T: …Né alright, alright. Now, mamela *(listen)*… Listen. | |
| | | 607.Ll: She copied me. | | |
| 49:08 | 48:44 | 608.T: who copied you? | | |
| | 48:48 | 609.Ll: Zukiswa. | | |
| | 48:49 | 610.Lz: He's lying. | | |
| 49:10 | | 611.T: She said it before, she said it before. Listen. (Points at +6) positive six plus, plus, plus negative two. Who…? Now, first very important. Who is big? Positive six and negative two? Who is big? | T: Mamela *(listen)*. Now, this is positive six né dibanisa *(add)* negative two né. Ngubani? *(Who is it?)* Now… First ke ngoku *(then now)* né… Ngubani omkhulu *(who is bigger)* positive six and negative two? Ngubani omkulu? *(Who is bigger?)* | |
| | | 612.Lb: (*Response not recorded).* | | |
| 49:47 | | 613.T: No (To Lb). Look (Points at +6 and -2 on the board). Who is big? *[Criterion that all positive numbers are big works in this instance].* | T: Uh uh. | |
| | 49:31 | 614.Ll: Six is big, six is big. | | |
| | 49:32 | 615.Ly: It's six, six, six. | | |
| 49:52 | 49:32 | 616.Lz, Ln: Two *[These learners have not acquired the criterion that positive numbers are big].* | | |
| 49:53 | | 617.T: That's it (Points at Ll). You are right. Six, positive six is big. Positive six is big. Positive… (Looks at Babalo). We said positive six is big. When we add, when we do addition, it is important to first look at the number that is big. I said it is important to look at the number that is big. He said (refers to Ll) positive six is big. | T: Good. U-six, positive six mkhulu né. U-positive six mkhulu, ne? *(Positive six is big. Positive six is big).* U-positive… hayi, Babalo *(No, Babalo)*. Positive six sitheni? *(Positive six, what did we say?)* Mkhulu né *(It's big)*. Xa sidibanisa né xa sisenza Addition né ku-important first ujonge, ujonge i-namba enkulu. *(When we add, when we do Addition, it is important first to look at the big number).* Siyavana? *(Do you understand?)* Ku-important ukuba uthini? *(It's important to do what?)* Ujonge inamba enkulu. *(To look at the big number).* Siyavana? *(Do you hear?)* Uthi uLeonardo né upositive six utheni? *(Leonardo said positive six is what?)* Mkhulu né *(It's big)*. | |
| | 50:24 | 618.Lz, Ln, Ll: It's big. | | |

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| 50:47 | | 619.T: Which means, now, now we take, take the sign before who? Six. Because, remember I said (Points at the number line) I said all the numbers that are positive, positive, positive say what? They are big. I said it. Do you remember? Do you remember? | T: So, which means now, now siza wuthatha siza wuthatha né i-sign e-before, e-before bani? *(We are going to take the sign before, before who?)* u-Six *(Six)*. Because remember besithe apha sathi zonke inambas positive, positive, positive, positive, zitheni? *(Because remember we said here all the numbers that are positive are what?)* Zinkulu *(They are big).* Andithi besitshilo *(Isn't that what we said?)* Khumbula? Uyakhumbula? *(Remember? Do you remember?)* | |
| | 50:57 | 620.Ly: I remember. | | |
| 51:16 | | 621.T: I said all the numbers that are negative, negative, negative are small. | T: I said zonke inambas negative, negative zitheni? *(All the numbers that are negative are what?)* Zi… né. | |
| | 51:06 | 622.Ll: Small. | | |
| 51:26 | | 623.T: (Points at +6). Positive, positive six says what? It's big. Negative two says what? It's small. | T: So now lo u-positive six utheni? *(This positive six is what?)* Mkhulu né *(it's big)*. Then u-negative two utheni? *(Then what is negative two?)* Mncinci né *(it's small)*. | |
| | 51:19 | 624.Ll: It's small. | | |
| 51:39 | | 625.T: Now, because we are doing Mathematics, because now we are saying plus, plus, plus (Draws a square around the addition sign of both sums and points at them). Now, what are we saying? Addition, addition, addition. Which means now we are saying take the sign of the number that is big. The sign, who is the sign before six? Who is it? | T: So now, ke ngoku, because ngoku né sisenza i-maths because ngoku siyathini? Siyadibanisa, dibanisa né lo… né… *(Now, because now we do maths because now we do what? We add, add, add this…)* Ngoku senza ntoni? *(Now, we do what?)* Siyadibanisa, dibanisa, dibanisa né. *(We add, add, add).* Which means now, siza wuthini siza wuthatha i-sign yenamba etheni? *(What are we going to do? We will take the sign of which number?)* Enkulu ne *(The big one)*. Isign, ngubani isign ebefore six, ngubani? *(Who is the sign before, before six? Who?)* | |
| | 52:05 | 626.(Learners do not respond). | | |
| 52:25 | | 627.T: Before, before, before six; what is there? | T: Before, before, before u-six kukho ntoni? *(Before six there is what?)* | |
| 52:28 | | 628.Lb: It's big. | | |
| 52:29 | 52:11 | 629.Lv: It's big *[The learners may be using big as a synonym for positive].* | | |
| 52:29 | 52:11 | 630.Lz: Positive. | | |
| 52:29 | | 631.T: (To Lz) That's it. (Writes plus). It's plus. Now, the number that is big, it stands here. It's big. It stands here. It says what? It's big. The number that is big is six (Points at +6 on the board). We take away how many? Two. (Draws six lines on the board). Remember, I borrowed R6. I paid how much? R2. (Points at the last line. Draws a line through it). I gave it to him (Lb). (Crosses out another line). I gave it to him. How much is left? *[Teacher transforms the operation into subtraction].* | T: Plus, good ne. Ukho plus *(there is plus)*. Now ne, *la namba la namba inkulu ne nantsi (that number, that number is big, here it is).* Ime apha inkulu ne *(the big one is standing here)*. Siyavana? (*Do you agree?)* Ime apha itheni? *(What stands here?)* Inkulu ne *(it's big)*. So, kula namba inkulu ne uza wuthi u-six *(in that big number you say six)*. Nanku *(Here it is).* Ususe zibengaphi? *(You take away how many?)* Zibeyi two *(It's two)*. Nantsi, apha *(here it is)*. One, two, three, four, five, six, ne. Mna remember bendiboleke i-six rand *(You must remember I borrowed six rand).* Ndambhatala malini? *(I paid him how much money?)* i-R2. Le…ne…le… kwashiyeka zangaphi? *(This, how much is left?)* |  The teacher writes the sign of the big number as part of the solution  Teacher subtracts the whole numbers. |
| 53:38 | | 632.Ll: Four. | | |
| | 53:19 | 633.Lz: Four Rand. | | |
| | 53:20 | 634.Lv: Four. | | |
| | 53:20 | 635.Ln: Two Rand *[The learners are able to do the whole* | | |

| | | | | |
|---|---|---|---|---|
| 53:38<br><br>54:01 | <br><br>53:41 | *number calculation].*<br>636. T: Four Rand. Which means, positive (Points at + sign of +6) 6 take away two, how many are left? Four. Six take away two, how many are left? Four.<br>637. Lz, Ln, Lv: Four.<br>638. T: (Writes 4). Do you see that? This (Points at 4) is whose money? Babalo's. He must get from who? Nomhle. Because how much did Babalo lend? Six rand. How much did I give him? R2. So me again I said what? I gave him? Four rand. | T: Four Rand ne. So which means ke ngoku positive ne that sign, six susa two kushiyeka bani? Four ne. Six susa two kushiyeka bani? Four. *(Now, positive six take away two, you left with who? Four. Six take away two you left with who? Four.)*<br><br>T: Siyayibona? Siyabona? *(Do you see it? Do you see it?)* Lena iseyi imali nkabani? *(This is still whose money?)* NkaBabalo *(Babalo's)* Etheni azayifumana ngubani? *(He is going to get it from who?)*Ku-Nomhle *(Nomhle)* ne because kaloku uBabalo ebendiboleke malini i-six rand ne *(because Babalo loaned me money, six Rand).* Mna ndamnika malini? *(Me, I gave him how much?)* i-two rand *(R2). S*o mna again mna funeka ndimthini ndimnike ntoni? *(So again what must I do, what must I give him?)* Siyavana, siyavana? *(Do you agree? Do you agree?)* Okay. | <br>Four is written next to the positive sign as the solution. |

**Criteria for adding a positive and negative integer using the example +6 + -2:**

- When doing addition, first determine the big number. This criterion is ambiguous as the teacher previously stated that all positive numbers are big.
- When doing mathematics and addition, take the sign of the big number (positive in this case). The teacher restates the criteria that all positive numbers are big and all negative numbers are small.
- Write the sign (positive) as part of the solution after the *is equal to* sign
- Subtract the small number from the big number (6-2=4). The teacher has emphasised that the operation is addition, however has now transformed the calculation into a subtraction problem.
- Write 4 next to the positive sign in the solution. The solution is a whole number which is written next to a sign.

## Evaluative Event 4.3 Two negative integers: $-3 + -5 = -8$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 54:40 | | 639.T: Now, (Writes on board). This (points at -3) is negative three, negative three. | T: Now… mamela ke ngoku, mamela ke ngoku. *(Listen now, listen now).* Apha, ne ngubani? *(Here, who is it?)* Negative, negative three. |  The objects are two negative integers |
| 55:16 | | 640.(Learner's response not recorded). | | |
| 55:17 | | 641.T: This (Points at -3) is negative three (Draws a rectangle around -3. Then draws a rectangle around -5). It's negative 5. It's negative three plus negative five. Negative three (Points) is the same as what? Negative five. The sign before is negative (Points at -3). And this? Negative 5 (Points at -5). Do you hear? Do you hear? | T: Hayi *(no)*, follow. Negative three ne. Le *(this)*… ne. Again lena ibe ngubani? *(Again, this one must be who?)* Ibe ngu-negative five ne, ne? *(It must be negative five)* Siyavana? *(Do you agree?)* Negative three, nega plus, plus negative five ne apha uyabon'uba? *(Here, do you see this?)* Negative three iyafana nabani? *(Negative three is the same as who?)* No-negative five ne. *(As negative five.* I-signs, i-signs ezi before bani? *(These signs, signs before who?)* Negative apha *(here)*. Nalapha ngubani? *(And here is who?)* Ya ngu-negative *(yes, it's negative)*. Siyavana? Siyavana? *(Do you agree? Do you agree?)* | |
| | 55:48 | 642.Lz: (Nods). | | |
| 56:06 | | 643.T: This (Points at -3) is negative and this (points at -5) is negative. Now, an important thing you want to know. If, if the signs before the numbers are the same, take it like that because they are both negative. *[When two negative numbers are added, the solution is a negative number].* | T: Apha, negative, apha negative *(here is negative, here is negative).* Now, into e-important ekufuneka uyazi *(now something important you must know)*. If, if ne i-signs before, before inambas ziyafana, ne siza zithatha zinjalo because u-negative nomnye u-negative batheni, bayathini? *(If the signs before the numbers are the same, we take it like that because negative and another negative are what?)* Bayafana ne *(they are the same)*. | |
| | 56:19 | 644.Ln: The same. | | |
| 56:40 | | 645.T: Negative, negative, negative says what? They are the same. Which means negative, negative leave what? What is the other one? Negative. Do you hear? | T: Negative, negative, negative, negative, negative batheni? *(Is what?)* Bayafana *(they are the same).* Which means unegative, nonegative kuzoshiyeka bani? *(Which means a negative and a negative what must I leave?)* Omnye ubani? *(Another what?)* Unegative *(a negative).* Siyavana? *(Do you agree?)* | |
| | 56:36 | 646.Lz: (Nods). | | |
| 56:57 | | 647.T: This (Points at -3 and -5). What must I write here (Points at space after =)? A negative plus another negative, what must I leave? How much is it? (Points at the numbers) What is it? | T: Now, nanku *(there it is)*. Negative no-negative sibhala bani apha? *(Negative and negative what do we write here?)* U-negative umdibanise nomnye u-negative kuza kuphuma bani? *(A negative plus another negative what will you get?)* Negative, negative ngubani lo? *(Negative, negative who is this?)* | |
| | 56:51 | 648.Ll: It's eight. | | |
| | 56:51 | 649.Ln: Six. | | |
| 57:10 | | 650.T: It is the same. They are all the same. You take, it's the same, you take it it's the same. It means they are the same. (Writes – after =) because negative, | T: Bayafana oko koko *(They are all the same)*. Uhamba uhambe uman'ubachola ubadibanise ubachola ubadibanisa ubachola bonke baza wuthini? *(You go around picking them up and adding, picking them up* | |

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| | | negative, negative is the same. So what do we add? Three. | *and adding, picking them up and do what)* Baza wufana, ne baza wufana *(they'll be the same, they'll be the same*). Siyavana? *(Do you agree?)* So apha siza kubala e-negative *(So here we will write negative).* Because negative, negative, negative, negative befana siza udibanisa nabani? *(Because negative, negative are the same, we will add who?)* u-three *(three)*. |  The teacher writes a negative sign as part of the solution. |
| | 57:16 | 651.Lz, Ln: Three. | | |
| 57:35 | | 652.T: And who? Five. | T: Nabani? *(And who?)* Five ne? | |
| | 57:18 | 653.Lz, Ln: Five. | | |
| 57:39 | | 654.T: Who do we add? Three. | T: Siza kudibanisa bani? *(We will add who?)* U-three *(three).* | |
| | 57:23 | 655.Lv, Ln: Three. | | |
| 57:42 | | 656.T: And who? Five. | T: Nabani? *(And who?)* u-five ne *(five).* | |
| | 57:24 | 657.Lv, Ln: Five. | | |
| 57:44 | | 658.T: Now, who is three plus five? | T: Now, three plus five ngubani? *(Who is three plus five?)* | |
| | 57:32 | 659.Ll: Plus? | | |
| 57:51 | | 660.T: Yes. Three. | T: Ewe *(yes)*. Three. | |
| 57:53 | 57:34 | 661.Ll: Three? | | |
| 57:53 | | 662.T: What is three plus five? | T: Three plus five ngubani? *(Who is three plus five?)* | |
| 57:57 | 57:39 | 663.Ll: Eight. | | |
| 57:58 | | 664.T: Yes. (Points at the problem) he says… listen… he says negative three plus negative five is what? | T: Eight ne. Ithi ke ngoku le *(this one says now…).* Mamela *(Listen).* Ithi negative three plus negative five ngubani? *(It says negative three plus negative five is who?)* | |
| | 57:52 | 665.Lz: Eight. | | |
| | 57:52 | 666.Lv, Ln: Eight. | | |
| 58:12 | | 667.T: Eight what? | T: Eight unantoni? *(What does eight have?)* | |
| | 57:55 | 668.(Learners do not respond). | | |
| 58:15 | | 669.T: Listen, listen. (Points at -3). We said negative three plus negative five is what? | | |
| 58:27 | 58:08 | 670.Ll: Negative, negative… | | |
| 58:26 | | 671.T: That's it! | T: Ewe *(yes).* | |
| 58:28 | 58:11 | 672.Ll: …Six. | | |
| 58:29 | | 673.T: No! | T: Hayi *(no).* | |
| 58:30 | 58:12 | 674.Ly: Negative, negative. | | |
| | 58:12 | 675.Lz: Eight *[The elements making up the solution are produced by different learners].* | | |
| 58:31 | | 676.T: That's it! Good. It's negative eight. (Writes 8). Negative three plus negative five is what? Negative eight. | T: Eight! Good, Zukiswa. It's negative eight ne. So negative three plus negative five ngubani? *(Who is negative three plus negative five?)* Negative eight ne. |  The teacher writes 8 next to the negative sign. |



**Criteria when adding two negative integers -5 and -3:**

- Negative three is the same as negative five because the signs preceding the numbers are the same, i.e. negative
- If the signs preceding the numbers are the same, the solution will have the same sign.

- When two negative numbers are added, the solution will be a negative number.
- Write a negative sign as the solution.
- Add the integers as whole numbers.
- The answer is written next to the negative sign as part of the solution.

### Evaluative Event 4.4: A positive and negative integer: $-8 + +4 = -4$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 58:50 | | 677. T: Lastly… (Writes a new problem on the board). Now, negative and positive. I'm saying this (points at -8)… | T: Eyokugqibela *(lastly)*… heke *(yes)*. Now, negative ne and positive. Ngoku… apha *(Now…here).* | |
| 59:34 | | 678. T: (Points at video.) Must I continue? (Waits for a few seconds then proceeds with lesson). | |   |
| 59:49 | | 679. T: (Points at -8) negative eight plus positive four. Negative eight plus positive four. Now, I'm asking when a boy meets… a boy meets… he's here and the girl is here. (To Lb): Come stand here. | T: Negative eight plus positive four ne. Negative eight plus positive four ne. Now, mandinibuze xa udibanisa inkwenkwe ne ne dibanisa ne inkwenkwe ngapha ne *(let me ask you when you add a boy, add a boy this side)*. Now, ibe yintombi umzekelo. *(Now, to be a girl this side)* For example. Yiza *(come).* | The objects are a negative and positive integer |
| 1:00:23 | 1:00:04 | 680. Lb: (Gets up and stands in front of the classroom). | | |
| 1:00:27 | 1:00:07 | 681. T: Come here (To Lv). | T: Yiza Vuyiswa *(Come, Vuyiswa).* | |
| 1:00:28 | | 682. Lv: (Gets up and stands next to Lb). | | |
| 1:00:36 | 1:00:17 | 683. T: Look here. Look here. What do they both have? (Points at Lb's pants). What do both have? Pants. Both of them, what are they wearing? Pants. Now, what is this (Points at Lb)? | T: Okay, masibajonge, masibajonge. Siyabone bobabini banxibe ntoni? Bobabini banxibe ntoni? Ibrukwe ne. Bobabini ne banxibe ntoni? Ibruk heke. Now, lona uyintoni? *(Let's look at them, let's look at them. We see they are both wearing what? They are both wearing what? Pants. Both are wearing what? Pants, right? Now, what is this one?)* | |
| | 1:00:35 | 684. Ln: A shirt. | Ln: i-Shirt *(a shirt).* | |
| 1:00:55 | | 685. T: No, is this a boy or a girl? | T: Huh uh. Lo uyintoni? Inkwenkwe. *(This one is what? A boy).* | |
| | 1:00:39 | 686. Ll, Lz, Ln, Lu: A boy. | | |
| 1:00:58 | | 687. T: A boy. And this (Points at Lv)? | T: Inkwenkwe *(A boy)*. Lo uyintoni? *(This one is what?)* | |
| | 1:00:41 | 688. All learners: A girl. | | |
| 1:01:01 | | 689. T: A girl. But what are they both wearing? | T: Intombi ne. *(A girl)* Siyavana? *(Do you agree?)* But bobabini banxibe intoni? *(But both are wearing what?)* | |
| | 1:00:49 | 690. Ln: Pants. | | |
| 1:01:10 | | 691. T: What are they wearing? Pants. | T: Bobabini banxibe intoni? Ibrukwe ne. *(Both are wearing what? Pants).* | |
| | 1:00:52 | 692. Ln: Pants. | | |
| 1:01:14 | | 693. T: Now, I want to know. Because they are both wearing pants, are they the same? Are the two of them the same? [*The teacher uses a metaphor to compare positive and negative numbers*]. | T: Now, ndifuna ukwazi ne because bobabini enxibe ibrukwe bayafana? Bayafana bobabini? *(Now, I want to know, because both are wearing pants, are they the same? Are they both the same?)* | |
| 1:01:24 | 1:01:03 | 694. Lz: No. | | |
| 1:01:25 | | 695. T: Are they the same? | T: Bayafana? *(Are they the same?)* | |
| | 1:01:05 | 696. Lu, Ly, Ll: they are different. | | |

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| 1:01:27 | | 697.T: They are different. What is he? He is a boy. And she? She is a girl. Which means they are different. He will stay… Whether he wears a dress or a pants he stays a? Boy. She (refers to Lv) Now do you see what she's wearing? Pants, but what is she? A girl. [*The metaphor seems to compare the boy and girl to positive and negative numbers. Positive and negative numbers are not the same. Even if the numerals (pants) are the same, they are different because of the signs, e.g. +2 and -2*]. | T: Abafani, abafani. *(They are not the same, they are not the same).* Lo yintoni? *(This one is what?)* Yinkwenkwe. *(A boy)* Lo yintoni? *(This one is what?)* Yintombi ne *(A girl).* Which means batheni? *(Which means what's wrong?)* Abafani ne? *(They are not the same).* Lo uyawuhlala nob'uxibe ilokwe nob'unxibe ibrukwe *(This one will remain whether he wears a dress or a pants)*. Uyawuhlala eyintoni? *(He will remain what?)* Eyinkwenkwe *(a boy)*. Lo na ngoku siyambona ukuba unxibe yintoni? *(This one now we see is wearing what?)* Unxibe intoni? *(What is she wearing?)* Ibrukwe *(pants.* But uyintoni yena? *(But what is she?)* Intombi ne *(A girl).* | |
| 1:02:00 | | 698.T: She is wearing pants but she will stay what? A girl. Many have pants but they stay a girl. Ok? You can go sit. | T: Lona unxibe ntoni? *(This one is wearing what?)* Ibrukwe but uza uthini? *(pants, but what is she going to be?)* Uza uhlala eyintoni? *(She will remain what?)* Eyintombi *(a girl).* Noba angazinxiba ibrukwe zibeninzi zibeninzi, zibeninzi, zibeninzi but uza uhlala eyintoni? *(Even if he wears many, many, many pants but he will remain what)* Eyinkwenkwe ne *(a boy).* Siyavana? *(Do you agree?)* Heke *(yes).* | |
| 1:02:20 | 1:02:03 | 699.Lv, Ll: return to their desks. | | |
| 1:02:22 | | 700.T: They are different. Their age is the same but they are different. Their years are the same. Maybe he is thirteen and she is thirteen but they are different because he is a boy and she is a girl. [*The learners' genders, which are different, are compared to the positive and negative signs. Their ages are compared to the numerals*]. | T: Which means abafani *(they are not the same)*. Noba iminyaka yabo itheni? *(Even if their age is what?)* Iyafana but bona batheni? *(It's the same but they are what?)* Abafani *(not the same)*… Nob'iminyaka yabo itheni? *(Even if their age is what )* Iyafana *(the same)*. Lo une-thirteen nalo una-thirteen but abazi kuthini? *(This one is thirteen and this one is thirteen but they won't be what?)* Abafani *(they are not the same).* Because yena uyintoni? *(He is what?)* Uyinkwenkwe *(A boy)*. Abe yena eyintoni? *(What is she then?)* Abeyintombi. *(A girl)* Ne, ne? Okay. | |
| 1:02:53 | | 701.T: It's the same. (Points at -8 and +4) if you look at positive, it's the same[12] as who? Negative. This (Points at -8) says negative and what does this say (Points at +4)? Positive. Do you hear? Do you hear? [*There is a discrepancy between the signing and the spoken language. The teacher has signed the opposite to what she is saying which contradicts the use of the metaphor*]. | T: Same ke nalapha apha … if uyajonga u-positive akafani nabani? *(Same as here… if you look a positive is not the same as who?)* Nonegative *(as negative)*. Apha le itheni? *(Here, it says what?)* I-negative *(negative)*. Le inamba itheni? *(This number says what?)* Positive? i-positive. Siyavana? Siyavana? *(Do you agree? Do you agree?)* Okay. | |
| | 1:02:52 | 702.Ln, Lz: (Nod). | | |
| 1:03:16 | | 703.T: It means it is different. All are plus but there's a problem because they are the same[13]. They are the same. We say they have to be the same. We say they have to be the same but they are different. [*The teacher signs the word "same" instead of "different". Her spoken* | T: So, zitheni? *(So, what is it?)* Is that… Ewe zonke ziyazthini siyazdibanisa but ke ngoku i-problem ikhona because zitheni? *(Yes, we add them all but there is a problem because what's wrong?)* Azifani ne *(they are not the same)*. Azifani *(they are not the same)*. Ewe, kuthwe masizithini masizidibanise ne *(Yes, they said what must we do? Add* | |

[12] Teacher uses the incorrect sign for "different". She uses the sign for "same".
[13] Teacher again uses the sign for "same" instead of "different".

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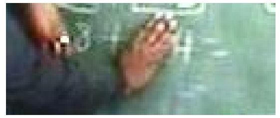
| | | *language clarifies what she means, however the learners cannot hear the spoken language. The criteria are contradictory due to the incorrect signing*]. | *them)*. Kuthwe masithini? *(They said we must do what?)* Masizidibanise but zitheni? *(Add them, but what's wrong?*) Azifani, ne *(they are not the same).* | |
| 1:03:40 | | 704.T: This (Points at -8) is negative eight and this (Points at +4) is positive four. Now I want to know…listen. An important thing you want to know when we add, add, add[14] you start to look here (Points at number line). (Points at -8) When you add, it is important to look which number is big. When you finished looking… (Looks at Lb). When you finished looking at the number that is big, you take the sign of the number that is big. | T: Lena negative eight, lena ngubani? Positive four ne. Now, ndifuna ukwazi mamela ke. Mamela. Enye into e-important ekufuneka siyazi ne. Xa sizidibanisa, dibanisa, dibanisa, dibanisa, dibanisa, dibanisa akufani nelaxesha besiqala pha ne. Apha xa sizidibanisa ku-important ujonge inamba etheni? Enkulu ne. Wawugqiba, wawugqiba, wawugqiba ukujonga… Babalo. Wawugqiba ukujonga inamba etheni? Enkulu ne. Uthathe ntoni? I-sign yenamba etheni? Enkulu. *(This is negative eight, who is this? Positive four. Now, I want to know, listen. Another important thing you need to know. When we add, add, add it's not the same as in the beginning. Here, when we add it is important to look at the numbers that are what? Big. When you finished, finished, finished looking… Babalo. When you finish looking at the number that's what? Big. You took what? The sign of which number? The big one.* |  |
| 1:04:40 | | 705.T: Now (Covers positive and negative signs with her hands) which one is bigger between 8 and 4? | T: Now, ngubani? Siyabona? Ngubani omkulu u-eight no-four? *(Now, who? Do you see? Who is big, eight and four?)* | |
| | 1:04:28 | 706.Ll: They meet together. | | The teacher covers the signs with her hands to indicate that the numerals should be considered without the signs. |
| | 1:04:29 | 707.Ln: Eight. | | |
| 1:04:52 | | 708.T: Who? | T: Ngubani? *(Who?)* | |
| | 1:04:32 | 709.Lz, Ln: Eight. | | |
| | 1:04:32 | 710.Ll: Eight is big .[*The learners are able to order the whole numbers*]. | | |
| 1:04:53 | | 711.T: Eight, yes. What is the sign before eight? What is before eight? | T: U-eight. U-eight ne. ithini, ithini i-sign e-before u-eight? Ithini? Before, before u-eight kubhalwe ntoni? *(Eight, eight. What does it say? What does the sign before eight say? What does it say? What is written before eight?)* | |
| | 1:04:45 | 712.Lz: Four. | | |
| 1:05:04 | | 713.T: No, before . | T: Huh uh. | |
| | 1:04:47 | 714.Lz: Minus, minus. | | |
| 1:05:07 | | 715.T: Yes, minus, minus, minus. When you add, you take the sign of the big number. This (Points at sum) which number is big? Eight. So the take the sign before which is what (Points at Lz)? | T: Xa sidibanisa sithatha i-sign yenamba etheni? Enkulu ne. Which means apha inamba enkulu ngubani? ngu-eight. Siza wuthatha la sign itheni? I-before. Which is ngubani, Zukiswa? *(When we add we take the sign of what number? The big one. Which means the big number here is what? Eight. We take which sign? Which is who, Zukiswa?)* | |
| | 1:05:11 | 716.Lz, Ln: Minus. | |  |
| 1:05:32 | | 717.T: Minus (Writes – on board). Now, eight and four, are they the same? | T: Negative ne. Nantsiya ne *(there it is)*. Now, u-eight no-four bayafana? *(Are eight and four the same?)* | |
| | 1:05:23 | 718.Lz, Ln, Lu: They are different. | | |
| 1:05:43 | | 719.T: They are different. Eight is big. What is four? | T: Ne. U-eight utheni? Mkulu. U-four utheni? *(Eight is what? Big. Four is what?)* | The teacher writes the sign of the big number (negative) as part of the |
| | 1:05:32 | 720.Lz, Ln: It's small. | | |

[14] Teacher used the incorrect sign for "add".

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| 1:05:53 | | 721. T: It’s small. Why are you laughing (To Ly)? Why are you laughing? | T: Ncinci, ncinci. Hleka ntoni? Yongama, hleka ntoni? Hayi uyahleka. *(Small, small. What are you laughing at? Yongama, what are you laughing at? Oh no, you are laughing).* | solution |
| 1:06:08 | 1:05:48 | 722. Ly: It’s him (Points at Lb). | Ly: Nanku *(there he is).* | |
| 1:06:09 | | 723. T: When we are finished, Rubina will have a photo of your work. Whether you were good or playing. We are saying eight and four are different. | T: Uyabona ngoku? Ndiza kugqiba ngoku. Ndifuna U-Rubina, u-Rubina makakufote azo wubona xa usebenza. Ngoba kumnandi ngoku uyadlala. Ndizakuninika umsebenzi ngoku. Awumamelanga wena. Okay sithe u-eight no-four batheni? Aba… abafani. Ba-different. Siyavana? *(Do you see now? I am ending off. I want Rubina to take photographs of you while you are working because it’s nice now you are playing. I am going to give you work now. You are not listening. Okay, we said eight and four are what? They are not the same. They are different. Do you agree?)* | |
| | 1:06:14 | 724. Ln: They are different. | | |
| 1:06:38 | | 725. T: Now, eight take away four is what? | T: Now, u-eight ususe u-four. Kushiyeka bani? *(Now, eight take away four. You are left with what?)* | |
| | 1:06:25 | 726. Lz: Four. | | |
| | 1:06:27 | 727. Ll: Positive four is left [*Learners responds with incorrect sign*]. | | |
| | 1:06:25 | 728. Ln: Four is left. | | |
| 1:06:48 | 1:06:28 | 729. T: Wait (To Lz). (To Ly): What is eight take away four? | T: Eight susa four kushiyeka bani? *(Eight take away four, you are left with what?)* | |
| 1:06:52 | 1:06:31 | 730. Ly: Nine. | | |
| 1:06:53 | 1:06:32 | 731. T: What? | T: Huh? | |
| 1:06:53 | 1:06:33 | 732. Ly: Nine. | | |
| 1:06:56 | 1:06:36 | 733. T: Eight take away four, how much is left? | T: u-Eight, eight, eight, eight ususe u-four kushiyeka bani? *(Eight take away four, you are left with what?)* | |
| 1:07:02 | | 734. Ly: Four. | | |
| 1:07:03 | 1:06:41 | 735. T: Why did you first say nine? You are playing. (Goes to the board). We are saying negative eight plus positive four is negative four. (Writes on board). Negative eight plus positive four, how much is left? Negative four. [*Teacher’s language indicates a subtraction problem*]. | T: Huh? Ngelixesha bekungathi kushiyeka unine. Bekutheni? Uyadlala wena. So negative eight plus positive four, kushiyeka bani? Ngunegative four ne. So negative eight plus positive four kushiyeka bani? Unegative four ne. *(At the time it was as if the answer was nine. What was wrong? You are playing. So negative eight plus four, you are left with what? With negative four. S negative eight plus positive four, you are left with what? Negative four).* | |
| 1:07:36 | | 736. T: When we add, we look where the big number is and we take what? The sign of what? The number that is big. When you are finished, the sign will be the same. When you finished, it is negative. Do you understand? | T: Remember sithe xa, xa sidibanisa ne siyajonga yeyiphi inamba? Enkulu. Sithathe ntoni? La sign yantoni? Yenamba etheni? Enkulu ne. Sawugqiba because i-sign zingafani ne. Sawugqiba sithini? Sithabathe ne. Siyavana? *(Remember, what did we say when we add? We look at which number? The big one. We take away what? That sign of what? Which number? The big one. When you finish because the signs are not the same. When we finish we do what? You subtract. Do you agree?)* |  The teacher writes 4 next to the negative sign. |
| 1:08:07 | | 737. T: This one (Points at first problem) has positive, positive, positive. They are the same which means it will stay positive. Here (Points at second sum), there is a problem. Here (Points again) there is a problem because the signs before the numbers are the same (incorrect sign). This (Points at +6) is positive six and | T: Apha, apha positive, positive, positive, positive, positive, positive, positive bayafana ne which means uya wuhlala utheni? Upositive. Apha ingxaki ikhona ne apha, apha ne problem ikhona because i-signs before inambas zitheni? Azifani ne. Apha sino-positive six. Apha sibenobani? Sibenonegative two. Which means ke ngoku which means ke ngoku ingxaki itheni? Ikhona. Because kaloku isigns before inambas | |

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| | | this (Points at -2) is negative two. Which means there is a problem because the signs before the numbers are the same (incorrect sign). Now, what are we saying? We take the sign of what? The number that is what? Big. | zitheni? Azifani ne. Which means ke ngoku now uza wufuna sithini? Sithathe ntoni? Isign yantoni? Yenamba etheni? Enkulu. *(Here positive they are the same which means it will remain how? Positive. Here, there is a problem here, here there is a problem because the signs before the numbers are what? They are not the same. Here, we have positive six. Who do we have here? We have negative two. Which means now the problem is what? It's there. Because the same signs before the numbers are what? They are not the same. Which means now you will want us to do what? You take what? Which sign? Of which number? The big one.* | |
| 1:09:05 | | 738. T: Who is this (points at +6)? You know it. It's six. It's bigger than what? Two. That's why we say six minus two is what? Four. | T: Engubani? Engu-six. Siyayazi mos usix utheni? Umkhulu. Kunabani? Kuno-two ne. That is why ke ngoku sithe six ne ususe two shiyeka bani? Ngu-four. *(Who is it? It is six. We all know six is what? It's big. Than who? Than two. That is why now we said six take away two leaves what? Four).* | |
| 1:09:23 | | 739. T: (Points at +4) But this (Points at +) is the sign of six because we said six is big. Do you hear? (Points at -3 and -5). There is no problem because when you add a negative and a negative, you leave it like that. It is the same. If you take a boy and add another boy, there are two boys. If you take a boy and add another boy, there are two boys. [*The teacher draws a comparison between gender and positive and negative signs*]. | T: But apha isign ngubani? Ngu-six. Because kaloku u-six utheni? Umkhulu. Siyavana? Apha iproblem ayikho ne because negative sidibanisa nenye inegative kwakushiyeka kukho ntoni? I-negative ne. if uthathe inkwenkwe wayedibanisa nenye inkwenkwe kuza kubakho ntoni? Amakhwenkhwe ayi-two ne. If sithathe inkwenkwe sidibanisa nenye inkwenkwe kushiyeka kukho ntoni? Amakhwenkhwe ayi-two. *(But here who is the sign? It's six. Because six is what? It's big. Do you agree? Here there is no problem because when you add a negative with a negative, what are you left with? A negative. If you take a boy and add another boy, what will you be left with? Two boys. If you take a boy and add another boy, what are you left with? Two boys).* | |
| 1:10:04 | | 740. T: But (Points at fourth problem) if you take a boy and add it to a girl, then it's different. They will stay a boy and a girl. Ok? Here (Points at -3 and -5) there is no problem. Three… (Stops to look at one of the children). Negative three plus negative five, how much is left? Negative eight. Because these (Points at-3 and -5) are both negative. Do you hear? | T: But apha if uthathe inkwenkwe uyidibanisa nantoni? Nentombi. Abafani. Kuya kuhlala kukho ntoni? Inkwenkwe nantoni? nentombi. Siyavana? So apha problem ayikho. Ngubani ne… unegative ne three simdibanise unegative five kushiyeka bani? Unegative eight because kaloku ezi zoyi two negative and negative. Siyavana? *(But here if you take a boy and add with what? With a girl. They are not the same. It will remain what? A boy and what? And a girl. Do you agree? So here there is no problem. Who… negative three add to negative five, what is left? Eight because these two are negative and negative. Do you agree?)* | |
| 1:10:44 | | 741. T: Here (Points at -8) negative eight plus positive four. (Points at -8) Eight is what? It is big. Four is what? It's small. Now, it's important to look at the sign of the big number. Which is it? Look, it's negative. Why? Here (Points at-4). Now because you add, the sign is negative. (Points at -8) here eight minus four is four. Do you hear? Good. | T: Apha negative eight ne plus positive four ne. So there u-eight utheni? Mkhulu. U-four utheni? Mncinci. Now, ke ngoku ku-important masithini? Sijonge ba isign yenamba emkhulu ngubani? Uyabona ba ngubani? Unegative. That is why sithe ke apha ne. Now ke ngoku because isign zitheni zingafani ne siza uthini? Sithabatha ne. Sithi eight thabatha four kushiyeka bani? Four. Siyavana? Okay ne. *(Here negative eight plus negative four. So there eight is what? Big. Four is what? Small. Now, then, it is important to say what? To look for who is the sign of the big number. Can you see who it is? It's negative. That is* | |
| | 1:11:12 | 742. Lz, Ln: (Nod). | | |

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|---|---|---|---|---|
| | | | *why we said here. Now because the signs are not the same what are we going to do? We subtract. We say eight minus four, we are left with what? Four. Do you agree?)* | |

**Criteria for adding a positive and negative integer:**

- Positive and negative numbers are different due to the signs preceding them.
- When adding a positive and negative integer, it is necessary to first determine the big number.
- The number line can be used to determine the big number. The teacher does not explain how the number line can be used to determine which number is greater.
- The big number is determined by considering the numeral without the sign preceding it. By determining the big number, the integer is treated as a whole number without a sign.
- Take the sign of the big number.
- The sign of the big number is written in the solution.
- The two integers are different because of the signs preceding them so the operation needs to be transformed from addition to subtraction.
- Subtract the small number from the big number.
- Write the answer next to the sign of the big number written in the solution.

**Criteria for adding two positive integers:**

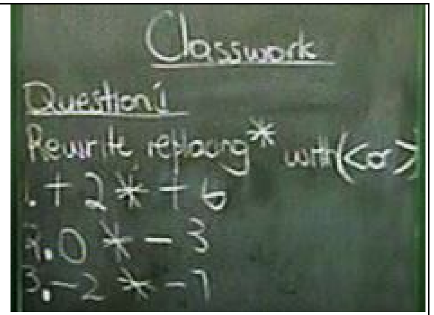
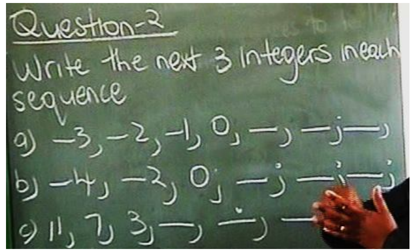
- A positive integer added to a positive integer will be another positive integer.

**Criteria for adding two negative integers:**

- A negative number added to a negative number is equal to a negative number.

## Evaluative Event 5: Learners write down their homework exercises

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 1:11:35 | | 743.T: Now I'm going to give you work to see who really, really understands. Take out your books and write. I've been talking and talking but the time is not finished. Rubina hasn't seen how you write. She wants to see how you write. Take out your books, take out your books. It's difficult, difficult to write. | T: Ndinganinika umsebenzi ukuba uyabona ukuba nyani, nyani, nyani understanda ukhona. Thatha iincwadi nize nibhala. Mna oh thetha, thetha, thetha. Hayi, alikapheli, alikapheli. Kufuneka URubina anibone ukuba nibhala njani. Nam ndinibone. Thatha incwadi thatha incwadi. *(Can I give you work to see if you really, really, really understood. Take out your books and write. I've been speaking and speaking. It's not finished, it's not finished (refers to time). I want Rubina to see how you write. I also want to see it. Take out your books, take out your books).* | |
| | 1:11:37 | 744.(Learners take out their books). | | |

| | | | | |
|---|---|---|---|---|
| 1:12:07 | | 745.T: (Writes on the board). | |  |
| 1:13:28 | | 746.Lv: (To T): I need a sharpener. | | |
| 1:13:36 | | 747.T: (Asks learners for a sharpener) . Give it to her (To Ly). | | |
| 1:13:44 | | 748.Ly: (Gives the sharpener to T who gives it to Lv). | | |
| 1:13:52 | | 749.T: (Continues to write). | | |
| 1:17:31 | | 750.T: Here (Refers to question 1) You must choose which one, this one (Points to <) or this one (Points to >). Big or small. Do you hear? Here, you must choose. Here (Refers to Question 2) Do you remember it's the same as this (Refers to work done on the board). This (Refers to Question 3) is the same. You add, add, add. | | |
| 1:18:01 | 1:15:47 | 751.(Learners write while T walks around and checks their work). | |  |
| 1:18:06 | | 752.T: Continue writing. | T: Qhubekani ukubhala *(continue writing).* | |
| 1:18:08 | | 753.Lu: Is this twenty? Is this right? | | |
| 1:18:12 | | 754.T: (Looks at the board. She corrects the numbering of the problems.) | | |
| 1:19:15 | 1:16:17 | 755.T: (Goes to Ly). Write here. | | |
| 1:19:23 | 1:16:24 | 756.(An announcement is made on the intercom) | | |
| 1:22:06 | 1:19:14 | 757.(The bell rings for the end of the period. Learners continue to write) | | |
| 1:22:06 | | 758.T: What's wrong (to Lz)? | | |
| | 1:19:16 | 759.Lz: I need an eraser. | | Question 3<br>1. (+5) + (+2) =<br>2. (+5) + (-2) =<br>3. (-5) + (-6) =<br>4. (-4) + (+6) = |
| 1:22:12 | 1:19:18 | 760.T: (Goes to Lz to look at her work). That's correct. It's right. | | |
| 1:23:12 | | 761.T: Listen. Now, we have a problem because the time is finished. Did you finish copying? Which means we will continue again but you must finish, finish it at home. I want to see it on Monday | T: Now problem ixesha ne ixesha. Nigqibile ukukopa? Finish, finish, finish? Finish, finish copy? Which means then again sifuna… continue. Aba gqibileyo finish, finish please nibhala home ne. Ndifuna kuyibona Monday. *(Now, the problem is time, time. Are you finished copying? Which means then again we want…continue. Those who are finished, you'll write it at home. I want to see it on Monday).* | |
| 1:23:40 | | 762.T: (To Ly): First, first copy. Did you finish copying? | T: First, first copy. Copy, copy gqiba *(finish)*? Finish, finish copy? | |
| 1:23:43 | 1:22:38 | 763.Ly: Yes. | | |
| 1:23:45 | 1:22:42 | 764.T: Let me see. Copy everything. | T: Khawuthi ndibone. Kopa yonke la nto *(Let me see. Copy all of that).* | |
| 1:24:10 | | 765.T: When you finish copying, please, please write it where? At home. You know, on Monday, I will mark it. Do you hear? Continue to finish copying. (To Ly): His problem is he will fail. I'm not worried. | T: So aba gqibileyo finish, finish ukopa ne please, please uyibhale phi? *(So those who have completed finish copying please where must you write it?)* Home. Sizo kwazi ukuba Monday sizokorekisha. Siyavana? *(We will correct it on Monday. Do you agree?)* Abanye bagqibezele ngoku *(The others must finish now)*. Problem yakho kaloku uza ku failisha *(your problem is you will fail).* | |
| 1:24:36 | | 766.T: (To Lv): Are you done? | T: Finish, finish? | |
| 1:24:37 | 1:23:32 | 767.Lv: Yes. | | |

| | | | | |
|---|---|---|---|---|
| 1:24:38 | | 768.T: Please do it where? At home. I will mark it on Monday. Good.<br><br>(End of Lesson One) | T: Please uza kubhala phi? *(Where will you write it?)* Home. Monday... | |

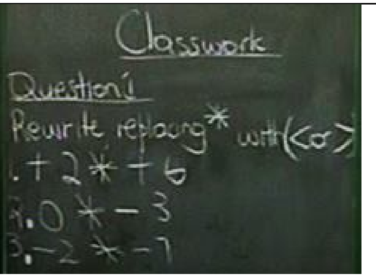
# Appendix H: Transcript and Analysis of a Grade Four Lesson on Integers (Lesson Two)

<u>Symbols</u>: T: Teacher's signing or speech
Lv, Lz, Ll, Ln, Lu, Ly: Individual learners' signing
T-DVD: Time taken from the DVD which focussed on the teacher
L-DVD: Time taken from the DVD which focussed on the learners

The spoken languages are English and Xhosa. The translation from Xhosa to English is italicised and in brackets. Comments are italicised and written in square brackets.

## Evaluative Event 1: Ordering of integers through three worked examples

### Evaluative Event 1.1: Ordering two positive integers: +2 and +6

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 00:08 | | 1. T: Remember the day we were busy talking about big and small. Do you remember? Do you remember? Ok, now I gave you work (Teacher refers to exercises on chalkboard). Do you remember? Now, I want to finish the work. Look here. Write (Points at instruction of Question 1). Choose which one, big or small. (Points at <) Who[15] is this? What does it mean? Big or small? | T: Remember, the day, busy, busy, busy talking about big and small. Now, I gave you umsebenzi (*work*). Uyakhumbula? (*Do you remember?*) Now, I want to finish, finish work né and see. Kukho apha *(there is here)*…Write…big, small né? Mean what? Big or small? | <br>Question one of homework exercises. |
| 00:45 | | 2. (*Learner's responses not recorded*)[16] | | |
| 00:50 | | 3. T: It's small. And this one (Points at >) This one? It's big. | T: Small, yes, small. And then, this one? Big. Ok. | |
| | | 4. T: Now, leave the star and choose maybe big or maybe small. Now, positive two—is it small or big with positive six? [*Teacher is restating her criteria as her previous criteria stated that all positive numbers were big. She now implicitly states that positive numbers can be compared*]. What is it? Choose which one, big or small? (Points at < and >) Which one is it? | T: So now, né, i-star lahla *(remove the star)*. U-chooze *(choose)* maybe big, maybe small. Now, one né. Plus two né is it big or small with plus six? Yeyiphi? Big chooze eyiphi? *(Which one, big choose which one?)* | |
| 01:14 | | | L: Four, four.[17] | |
| 01:16 | | 5. T: Who, who, who is big? | T: Who, who, who big? Who? | |
| 01:20 | | 6. T: He says six is … | T: Uthi six big, two… *(He says six is big).* | |
| 01:22 | | 7. Ll: Big. | | |
| 01:22 | | 8. T: Big. And two is… | | |
| 01:24 | | 9. Ll: Small [*Learners may be relying on their knowledge of whole numbers*]. | | |

[15] Educator signs "who" instead of "what" when referring to integers.
[16] The learners' responses were not recorded for the first nine minutes due to a technical error.
[17] A learner's response is heard on the video.

| | | | | |
|---|---|---|---|---|
| 01:25 | | 10. T: Ok, six is big and two is small. Now, who will help me to choose? (Erases the asterisks form Q1). Who will help to choose? Who will help to choose? He (Ll) said six is big and two is small. Ok, I agree. Now, help. Yongama, choose which one. Choose there. Go there and choose [*Learner has a 50% chance of choosing the correct sign*]. Go. | T: Ok, six big, two small. Now, ngubani oza help chooza eyiphi? *(Who is going to help me choose which one)*… Helpa, chooza yiza, chooze pha *(help, choose, come, choose there)*. Uthi né six big né, two small *(he says six is big, two is small)*. Ok, ndiyavuma *(I agree)*. Now, Yongama, Yongama help chooza eyiphi… Chooza kaloku. Hamba. *(Now, Yongama, help choose which one. Well, choose. Go).* | |
| 01:59 | | 11. Ly: (Goes to the board). | | |
| 02:04 | | 12. T: (Points at < and >). Choose which one. | T: Chooza eyiphi. Bhala… *(Choose which one. Write …)* | |
| 02:07 | | 13. Ly: (Points at >). | | |
| 02:08 | | 14. T: Write it there. [*Teacher tells learner to write his answer even though he has chosen the incorrect inequality sign. She sets him up for failure*]. | |  Learner has written the incorrect inequality sign. He has not acquired the teacher's criteria regarding representation of ordering. |
| 02:14 | | 15. Ly: (Writes >). | | |
| 02:16 | | 16. T: Is he right? Is he right? Is he right? Yongama says positive two is big and positive six is small. Is it true? It's wrong, it's wrong, it's wrong. Who will help? | T: Hmm? U-right? U-right? U-right? *(Is he right?)* Uthi (*says*) Yongama plus two big, plus six small. U-right? *(Is he right?)* Nyani? Nyani? Nyani? *(Is it true, true, true?)* It's wrong, it's wrong, it's wrong. Ngubani? *(Who?)* … Help. | |
| 02:32 | | 17. Lz: (Raises her hand). [*This learner is assured that she will produce the correct response*]. | | |
| 02:33 | | 18. T: You come up. | T: Ok, Zukiswa. |  |
| 02:44 | | 19. Lz: (Erases > from the board and writes <). | | |
| 02:52 | | 20. T: Is she right? Yes (Applauds). Which means positive two is big, positive two is small. (She is interrupted by someone at the door). Get out. Positive two is small with positive six. [*Teacher implicitly indicates that two positive numbers can be compared*].Plus six is what? It's big. This (Points at >) it's big. The mouth is open, it's big. It's small. (Her phone rings and she leaves to answer it). | T: U-right? *(Is she right?)* Ok, Ok. Which means né, plus two it's big, né plus two it's small. Plus two it's small, né with plus six né. Plus six utheni? *(Plus six is what?)* U-Big, né, né lena *(this one)*…big. | The second learner produces the correct response. |

**<u>Criteria with reference to inequality signs</u>:**

- The inequality sign < means small and the sign > means big. The teacher does not explain that the signs are relational and do not represent big or small in dependently of numbers.
- If the mouth is open, it's big. It is implicit that the open side of the sign faces the bigger number.

**<u>Criteria with reference to positive integers</u>:**

- Positive numbers can be compared. The teacher has modified the criteria as she previously stated that all positive numbers are big. She now implicitly states that positive numbers can be big or small when compared with other positive numbers.

## Evaluative Event 1.2: Ordering 0 and a negative integer: $-3$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 03:42 | | 21. T: Ok, look at me, look at me please. Now, which one is big and which one is small? Zero and minus three. Which one is big? Who is big? Remember, it's minus three and zero. Which one is big? Who? | T: Ok. Now which is big, which is small? Zero and minus three. Which one is big? Who big? Minus, remember it's minus three and zero. Which one is big? Who? | |
| 04:08 | | 22. Lz: Three is big. [*This learner thinks 3 is the same as -3*]. | | |
| 04:12 | | 23. Lz: Zero. | | |
| 04:13 | | 24. Lu: Three. | | |
| 04:13 | | 25. Ln: Three is small. | Ln: Three small. | |
| 04:15 | | 26. T: You (To Lz). | | |
| 04:16 | | 27. Lz: Zero is big [*This learner has changed her response. She seems to be guessing* ]. | | |
| 04:17 | | 28. T: And? | T: Ok, and? | |
| 04:18 | | 29. Lz: Three is small [*Teacher accepts the whole number response*]. | | |
| 04:20 | | 30. T: Good. She says zero is big and minus three is small. Come here (To Ln) and write it. Choose which one it is, choose which sign. | T: Ok, good. Good, né. Zero big né and minus three small Yiza lana Nangamso… Chooza eyiphi ke ngoku. Chooza eyiphi sign apha. *(Come, Nangamso. Choose which sign here now. Choose which sign here)* |  |
| 04:36 | | 31. Ln: (Goes to the board). Is it this one (points at <)? | | Learner produces incorrect sign on the board. |
| 04:40 | | 32. T: I don't know. | | |
| 04:44 | | 33. Ln: (Writes <) [*Learner has not acquired criteria for representation of the ordering*]. | | |
| 04:47 | | 34. Lv: She's wrong, wrong. | | |
| 04:48 | | 35. T: Nangamso says zero is small and -3 is big. Is that true, true, true? It's wrong. You (To Lb), come and help her. Leave your book (To Ll). | T: Which means, uthi Nangamso né u-zero small, minus three big. Nyani? Nyani, nyani, nyani, nyani? It's wrong. Helpa. Yiza. Incwadi phantsi… *(Nangamso says zero is small, minus three is big. Is it true, true, true? It's wrong. Help. Come. Put the book down)* |  The second learner produces the correct sign to represent the ordering. |
| 05:12 | | 36. Lb: (Erases < and writes >). [*This learner is assured of producing the correct response*]. | | |
| 05:17 | | 37. T: Ok, he says zero is big and -3 is small. | T: Ok. Uthi zero big, minus three ncinci (*small*) né. Ncinci *(it's small)*. Ok. | |

**Criteria:**

- The teacher's previous implicit criterion was that zero is smaller than all positive numbers.
- Negative numbers are less than zero.

**Comments:**

It appears that the all the learners have not acquired the criteria for representing ordering using the inequality symbols.

### Evaluative Event 1.3: Ordering two negative integers: $-2$ and $-7$

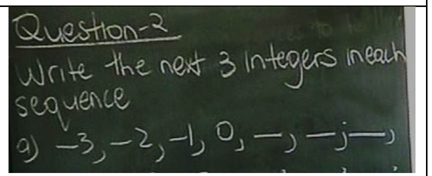
| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 05:28 | | 38. T: Ok, and this (Points at No 3.) Negative two and negative seven. Which one is big and which one is small? | T: Now, here minus two and minus seven which one is big and which one is small? | |
| 05:38 | | 39. (A learner calls out an answer which cannot clearly be heard on the video). | | |
| 05:39 | | 40. T: These two (Points at -2 and -7). Which one is big? Who? (To Lu): Come up. | T: Hayi (*no*), here. Big, which one? | |
| 05:50 | | 41. Lu: (Goes up to the board and writes >). | | |
| 06:05 | | 42. T: Is it true, true, true? Yes (Applauds). Minus two is big and minus seven is small [*Teacher implicitly provides the criterion for the representation of the ordering*]. It's true, true, true. Good. Thank you. We will continue. [*Learner may have acquired the criteria or previous learner gave incorrect answer*]. | T: Yes. Minus two big né minus seven… né? Nyani, nyani, nyani (*Is it true, true, true?)* Thank you. Now… |   A learner produces the required response. |

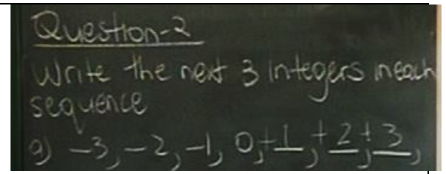
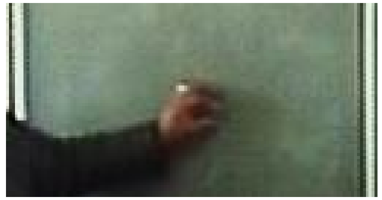
**Criteria**:

- Previous criteria were that all negative numbers are small.
- Criteria were then implicitly re-stated that negative numbers could be compared.

## Evaluative Event 2: Ordering sequences of integers using three worked examples

### Evaluative Event 2.1: Ordering sequences: Example 1: $-3, -2, -1, 0, \_, \_, \_$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 06:21 | | 43. T: (Reads the instruction of Q2). Write the next three numbers in each sequence. [*Teacher signs and says numbers even though the term 'integers' is written in the instruction*]. Now, here is -2, no minus three (Points at -3), (Points at -2) minus two, (Points at -1) minus one, (Points at zero) zero. And this? (Points at the three spaces) Who will help me? Come help me (To Lv). Who? Who? | T: Ok, now silapha (*we are here*). We here now, né. Write the next three numbers in each …. né? Ok, now, here we got minus two, no- (*and*) minus three, minus two, minus one, zero. Who? Vuyiswa, yizo sihelpa *(come and help us).* Ngubani? (*Who*?) |   The first example on ordering sequences of integers. |
| 07:02 | | 44. T: What do you think (to Ly)? Leave that now. | T: Ucingaphi? Susa isandla… *(What are you thinking? Take away your hand).* | |
| 07:09 | | 45. Lv: (Writes +1). | | |
| 07:10 | | 46. T: Continue to the last one. Do all of them. Finish it. | T: Gqibile yonke *(Finish all of it).* Finish, finish, finish yonke *(all of it)*. | |
| 07:13 | | 47. Lv: (Writes +2, +3). | | |

| | | | | |
|---|---|---|---|---|
| 07:17<br>07:18<br>07:19<br>07:20<br>07:23<br>07:25<br>07:27<br>07:28<br>07:29 | | 48. T: Is that true?<br>49. Lz: It's wrong, wrong.<br>50. T: Is it true, true, true?<br>51. Lz: It's negative, negative, negative.<br>52. T: Is it right? Is It?<br>53. Lv: (Returns to her seat).<br>54. T: What do you say? What is it?<br>55. Ll: It's true.<br>56. T: You (Points at Ll), it's true. (Applauds). Yes, yes. Remember, it's the same… (Pauses to talk to video crew). Can I continue? Good. Remember (Goes to the board and makes a zero with her hand on the board). This was zero. To the left was minus one and it continued. The right side of zero was plus one. Do you remember? (Goes to the other board and refers to Question 2). | T: Yes, yes. Remember, kaloku *(then)*... Must I hold on, né? Remember, that number line né we said here it was zero, minus one né, zero, plus one. Uyakhumbula? *(Do you remember?)* Ya. Né? Ok. Finish, finish. Thank you, thank you. Good. Help me. | <br><br>A learner has completed the sequence.<br><br>Teacher uses her hand to indicate zero on the number line which was written on the board in the previous lesson but has since been wiped clean. |

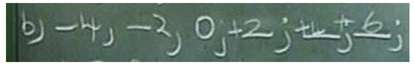
**Criteria regarding the number line:**

- Teacher relies on learners' knowledge of the number line for them to complete the sequence. The number line as a visual representation of the ordering of integers, is completely implicit as the teacher refers to it but does not draw it on the board.
- The number line has zero in the centre (implicit) with -1 to the left of it and +1 to the right.

### Evaluative Event 2.2: Ordering sequences: Example 2: $-4, -2, 0, \_, \_, \_$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 08:04 | | 57. T: Now, (Points at -4) minus four, (points at -2), minus two, (points at 0) zero. Who is here? (Points at 3 spaces which follow). Who? Who?<br>58. (Learners' responses not recorded). | T: Now, apha (*here*) minus four, minus two, zero… | <br>The sequence in example 2. |
| 08:20 | | 59. T: Minus four, minus two, zero and who goes there? Come, come, what do you say?<br>60. (Learners' responses not recorded). | T: Minus four né, minus two, zero and who now? Yizani, zani, zani. Uthini ngoku? *(Come, come, come. What do you say now?)* | |
| 08:41 | | 61. | T: Huh? | |
| 08:49 | | 62. T: (Points at-4) minus four, (points at -2) minus two, (points at 0) zero. (Points at first line) what goes here? | | |
| | 00:01 | 63. Lz: Minus two. | | |

| | | | | |
|---|---|---|---|---|
| 09:00 | | 64. T: Who? | | |
| | 00:03 | 65. Lz: Positive two. [*This learner changes her answer in response to teacher's question*]. | | |
| | 00:03 | 66. Lv: Minus three. | | |
| 09:01 | | 67. T: Come up, let me see. | | |
| 09:05 | | 68. Lz: (Goes up to the board and writes +2. She looks at T). | |  The first learner writes +2 in the sequence. |
| 09:17 | | 69. T: Who is after that? | | |
| 09:19 | 00:18 | 70. Ll: (To Lz) you must continue. | | |
| | | 71. Lv: Continue. | | |
| 09:19 | | 72. T: (To Ll): No, another person. I want another person. No, wait. I want another person. (To Lz): Good. Thank you, thank you, thank you. | | |
| 09:25 | | 73. Lz: (returns to her desk). | | |
| 09:25 | | 74. T: I want someone else. Who will help? | | |
| | 00:25 | 75. Lb: (Raises his hand) | | |
| 09:27 | 00:26 | 76. T: Don't tell. Who will help? | | |
| 09:28 | 00:27 | 77. Lb: I know it. | | |
| 09:29 | 00:28 | 78. T: (To Lb): Do you know it? Who? What do you say (to Lu)? | | |
| 09:31 | 00:31 | 79. Lu: Zero. | | |
| 09:32 | | 80. T: No, and you (to Ln)? | | |
| 09:34 | | 81. Ln: Two. | Ln: Ninety two, four. | |
| 09:36 | | 82. T: What? (Looks at the learners. | | |
| 09:37 | | 83. Lv: Positive four. | | |
| 09:38 | 00:36 | 84. Lz: I know. | | |
| 09:39 | | 85. T: Wait (to Lv and Lz). | | |
| 09:40 | | 86. Ln: Four. | Ln: Four. | |
| 09:40 | 00:38 | 87. T: You (to Ly), who is it? | | |
| | 00:39 | 88. Ly: Four. | | |
| 09:42 | 00:42 | 89. (Gives the chalk to Ly). Go up. | T: Quick, quick, quick, Yongama. | |
| 09:50 | | 90. Ly: (Goes to the board and writes +4). | |  The second learner has written +4. |
| 09:58 | | 91. T: (Applauds and gives him a hug). Good. My friend knows. Now, the last one. Who will do the last one? [*Teacher relies on the group to answer the question rather than individual learners*]. | T: Yeah! Good, good, good, good, good, good. Uyazile. Now, kugqibela bani? Ngubani? Gqibela? *(He knew it. Now, who is last? Who? Last?)* | |
| | 01:07 | 92. Lz, Lv: Six. | | |
| | 01:12 | 93. Lu: Five, five. | | |
| | 01:13 | 94. Ln: Me, me. | | |
| 10:09 | | 95. T: Be quiet; don't tell (to Lz). (Looks at the learners and claps her hands, choosing who to ask). | T: Ngubani, bani, bani, bani, bani? *(Who, who, who…?)* | |
| | 01:14 | 96. Ln, Lu, Lb: (Raise their hands). | | |
| 10:16 | | 97. T: Help, help. The last one. (Looks at learners while | | |

| | | | | |
|---|---|---|---|---|
| | | they raise their hands). | | |
| | 01:17 | 98. Lu: It's five, five. | | |
| 10:21 | | 99. T: Let's see… let me see who is awake? Who is awake? Who is awake? | T: Ndibonile ngoku, ndibonile ngoku, ndibonile ngoku. Vuka khona, vuka khona, vuka khona? *(I saw now, I saw now, I saw now. That you are awake, you are awake, you are awake).* | |
| | 01:27 | 100. Lu: It's six! | | |
| 10:29 | 01:28 | 101. T: (To Lu) Come up! Come! | T: Khawuze, khawuze *(please come, please come).* | |
| 10:31 | 01:30 | 102. Lu: I know it's six (goes up to the board). | | |
| | 01:36 | 103. Lv: I know. | | |
| 10:35 | 01:38 | 104. Ll: It's two, two and two. That's it. | | |
| 10:39 | | 105. Lu: (Writes 6). | T: Hmm? | |
| 10:42 | | 106. T: Is it just six? [*Teacher is referring to sign*]. | T: Six? Nje? *(Just)* | |
| | 01:44 | 107. Ln, Lz: It's positive. | | |
| | 01:45 | 108. Lv: Five. | | |
| 10:45 | 01:45 | 109. Ly: (Raises his hand). | |  |
| 10:45 | | 110. Lu: There should be a plus. (Writes + before 6). | | |
| 10:47 | | 111. T: That's it! (Applauds). Thank you, thank you. | T: Ya! Thank you, thank you. | The third learner completes the sequence. |
| 10:49 | 01:50 | 112. Lu: (Returns to her desk). | | |

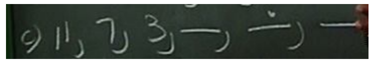
**Criteria:**

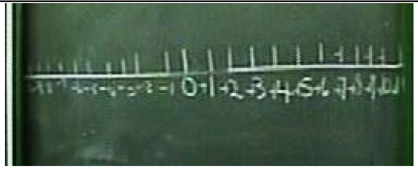
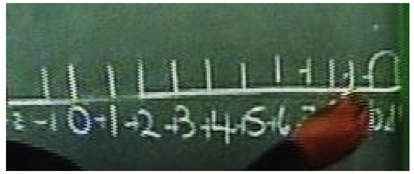
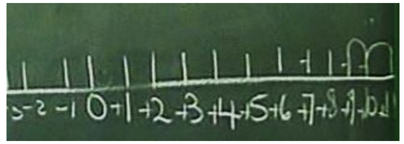
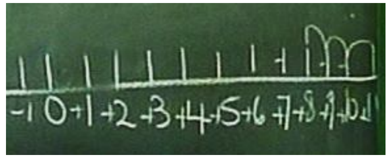
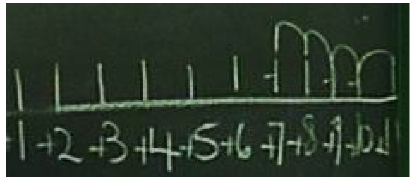
- The teacher does not generate criteria but seems to rely on the learners' knowledge of the number line to complete the sequence.

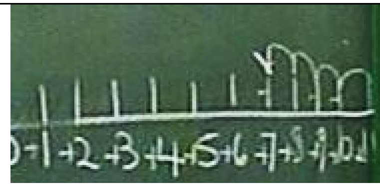
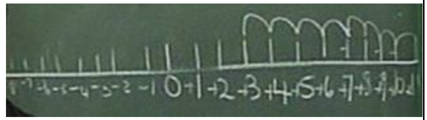
**Comments:**

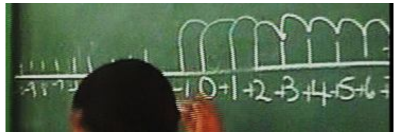
Learners as a group complete the solutions, rather than individual learners.

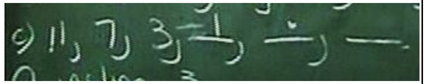
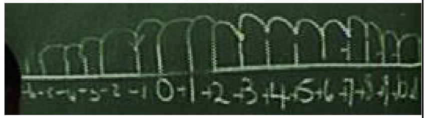
### Evaluative Event 2.3: Ordering sequences: Example 3: $11, 7, 3, \_, \_, \_$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 10:53 | | 113. T: Now (points at Question 2c). Now, (points at 11) eleven, (points at 7) seven, (points at 3) three, (points at 3 lines to be filled in)? | T: Now, now eleven, seven, three. |  Question 2c of the homework exercises. |
| | | 114. (Some learners repeat with teacher). | | |
| | 02:07 | 115. Lz: Positive… six, ten. | | |
| | 02:07 | 116. Ln: Negative… (raises her hand). | | |
| | 02:07 | 117. Lv: Positive four. | | |
| 11:13 | | 118. T: Eleven, seven… | T: Eleven, seven. | |
| | 02:13 | 119. Lb: (Cannot see response clearly). | | |
| | 02:17 | 120. Lz: Ten. | | |
| | 02:17 | 121. Lv: Positive four, positive four. | | |
| | 02:21 | 122. Ln: Plus five, plus five, plus five, plus five. | Ln: Plus five, plus five. | |

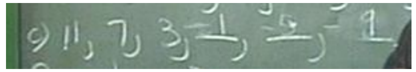
| | | | | |
|---|---|---|---|---|
| 11:23 | | 123.T: (Shakes her head). | |  Teacher draws a number line. |
| 11:25 | 02:24 | 124.Lz: Four. | | |
| 11:26 | 02:24 | 125.Lv: Positive four, positive four. | | |
| | 02:27 | 126.Ln: Positive eight, positive eight. | | |
| 11:28 | | 127.T: Look here (Draws a number line with zero at the centre, positive 1- 11 to the right and negative 1- 10 to the left). | T: Jonga (*look*), okay. | |
| | 02:30 | 128.Ln: (To Lv): It's positive eight, positive eight. | | |
| | 02:32 | 129.Lv: Be quiet. | | |
| | 02:43 | 130.Lv: It's plus four. I understand. | | |
| | 02:50 | 131.Ll: It's the time, time. One. Time, time. | | |
| 12:32 | | 132.T: Listen. Look at me. Now, do you see… leave that book (to Ll). Now, let's see. From eleven to seven, you walk how many? | T: Okay. Mamelani (*listen*). Okay. Now, né let us see. Bheka incwadi phantsi *(Put your book down)*. Now, let us see ngubani *(who?)* From eleven to seven uhamba kangaphi, né? *(You walk how many times?)* Okay. |  The teacher demonstrates one "walk" from 11 to 10. |
| | 03:52 | 133.Lz: Eleven. | | |
| 12:54 | | 134.T: From eleven… we walk how many times? Look (refers learners to number line) from eleven to where? From eleven to seven. Look, it walks how many, how many? Do you hear? I want to know how many times it walks. Do you hear? Look (on the number line, she draws a line from eleven to ten and looks at the learners). | T: From eleven. Nantsi, né *(here it is)*. Walk, walk how many times, né. Siya *(we go)* from eleven to where? From eleven to seven. Jonga ngubani, ngubani uhamba kangaphi? Siyavana? Ndifuna ubale, ubale, ubale uba uhamba kangaphi? Siyavala. Now… (Look who, who, it goes how many times? Do you agree? I want you to count, count how many times it goes. Do you agree? |  Two walks from 11 to 9. |
| | 04:31 | 135.Lu: One. | | |
| | 04:33 | 136.Lb: One. | | |
| 13:33 | | 137.T: It's one. (Draws a line from ten to nine). | | |
| | 04:34 | 138.Ln: Two. | Ln: Two. |  Another "walk" from 9 to 8 |
| 13:38 | | 139.T: It's two. | T: Two. | |
| | 04:36 | 140.Ln, Lu, Lb: Two. | | |
| 13:40 | 04:40 | 141.T: (Draws a line from nine to eight and looks at the learners). | | |
| 13:44 | | 142.Ln, Lu, Lb: Three. | Ln: Three. | |
| | 04:45 | 143.T: (Draws a line from eight to seven). | | |
| 13:46 | | 144.Ln, Lb: Four. | Ln: Four. |  The number of "walks" from 11 to 7 is four. |
| | | 145.T: Four. Which means it walked how many? | T: Four. Which means uhambe kangaphi? *(How many times did you go?)* | |
| | 04:48 | 146.Lz, Lv, Ln, Lb, Lu: Four. | | |
| 13:50 | | 147.T: Four times. Now, now again we walk from seven to three. Look there (refers to question on the board). Look, three again. (Makes a cross above the 7 on number line). It arrives, it's closed. Again, I want to say, again I say it walks. Again, from seven. Where is it going? | T: Ayi-four times, né. Now, now again né masihambeni *(let's go)* from u-seven to u-three né uba ubutshilo *(If you said so)*. Again apha *(here)*. Sifikile, ungavala né. Again sifuna ukuthini? Siphinde sithini? Siyahamba again. From kwa-seven siyaphi ngoku? *(We have arrived so you can close it. Again we want to do what? And again do what? We go again. From seven, where are we going now?)* | |
| | 05:15 | 148.Lv, Ln, Lu: Three. | | |

| | | | | |
|---|---|---|---|---|
| 14:16 | | 149.T: Three. Again, we count (draws line from 7 to 6). | T: Kwa-three *(to three)*. Again masibaleni *(let's count)*. Okay. |  Teacher makes a cross above the 7 on the number line |
| | 05:20 | 150.Ln: One. | Ln: One. | |
| 14:22 | | 151.T: (Nods). I want to hear all of you. | T: Nonke *(all of you).* | |
| | 05:23 | 152.Ln: One. | Ln: One. | |
| | 05:23 | 153.Lz: Five. | | |
| | 05:23 | 154.Lv: Five. | | |
| | 05:24 | 155.Lu: Five. | | |
| 14:26 | | 156.T: No, remember here (points at 7) it arrived here, it's closed. | T: Huh uh. Remember, lo apha sifikile, kwavalwa *(this, here we arrived and closed it).* | |
| | 05:27 | 157.Lu, Ln: Five. | Ly: Five, five. | |
| 14:29 | | 158.T: Wait, it arrived, it's closed. Again, it will start, it will start. | T: Yima sifikile, kwavalwa *(wait, we arrived, we closed it)* Again, siyaqala, siyaqala *(we are starting, we are starting)*. | |
| | 05:32 | 159.Lv: One. | | |
| 14:33 | | 160.T: That's it (points at Lv). It's one. | T: Ewe *(yes).* | |
| | 05:34 | 161.Lz, Ln: One. | Ln: One. | |
| 14:37 | | 162.T: (Draws a line from 6 to 5 and looks at the learners for a response). | | |
| | 05:39 | 163.Lv, Ln, Lz, Lu, Lb: Two. | Ln: Two. | |
| 14:43 | | 164.T: (Draws a line from 5 to 4 and looks expectantly at the learners). | | |
| 14:47 | 05:45 | 165.Lz, Lv, Ln, Lu, Lb: Three. | Ln: Three. | |
| | | 166.T: (Draws a line from 4 to 3 and looks at the learners) | | |
| 14:51 | 05:48 | 167.Lz, Lv, Ln, Lu, Lb: Four. | Ln: Four. | |
| | | 168.T: Again, how many did we go? | T: So, again siyaphi, kangaphi? *(Where are we going, how many times?)* | |
| | 05:52 | 169.Lz, Lv, Ln, Lu, Lb: Four. | Ln: Kayi-four *(Four).* | |
| 14:53 | | 170.T: Four. Good. Now, look here (refers to Question 2c). Look. From (points at 11 then 7) it walks how many? | T: Kayi-four, né. Now, uyabona ke ngoku? Uyabona ke ngoku? From here to here hamba kangaphi? *(Four. Now, do you see now? Do you see now? From here to here you go how many times?)* |  |
| | 06:00 | 171.Ly: Four. | Ly: Four. | |
| 15:03 | | 172.T: Four. Again, from here (points at 7 then 3) it walks how many? Four. Now, I want a person to help me. From (points at+3 on number line) it walks four. Who will see where it arrives? Who will help? Again, it walks four from three. Let's see who can tell the right number. (Gives the chalk to Lv). | T: Kayi-four *(it's four)*. Again from here to here uhambe kangaphi *(you go how many times)?* Kayi-four *(it's four)*. Now, ndifuna umntu oza ndihelpa from here walk, walk, walk kube kayi-four *(I want a person to help from here walk,walk four times.)* Ubone uza kufika kangaphi? *(You'll see you'll arrive after walking how many times)?* Ngubani oza ndihelpa? *(Who will help me?)* Again uhambe kube kayi-four from three ubona benza bani inamba e-right *(Again, you go four times from three and see which number is right)*. Yiza (*come*), Vuyiswa. | The number of "walks" from 7 to 3 is four. |
| 15:32 | 06:29 | 173.Lv: (Goes to the board). | | |
| 15:33 | | 174.T: I want it to walk four (makes a mark at +3). From there (points at number line) it walks 4. | T: Ndifuna ahambe kube kayi-four. From here… uhambe bengayi-four *(I want you to go four times. From here, go four times).* | |
| 15:46 | | 175.Lv: (Draws a line from 3 to 2) It's one. | Ln: One. | |
| | 06:45 | 176.Ln: One. | | |
| 15:48 | | 177.T: Yes. | | |

| | | | | |
|---|---|---|---|---|
| 15:49 | | 178.Lv: (Draws a line from +2 to +1).Two. (Draws a line from +1 to 0) three. | |  Learner counts four “walks” from +3 to -1 |
| 15:55 | | 179.T: Three. | | |
| 15:56 | | 180.Lv: (Draws a line from 0 to -1). Four. | | |
| | 06:56 | 181.Ln: Four. | | |
| 15:58 | | 182.T: Which means, who do we write here? (Points at Question 2c). Who is there? (points at number line). | T: Which means ngubani ke apha? Ngubani lo? *(Which means who is here? Who is this?)* | |
| 16:03 | | 183.Lv: Four. | Ly: Four. | |
| 16:04 | | 184.T: Look there (points at number line). Who is there? | | |
| 16:07 | | 185.Lv: Three. | | |
| 16:08 | | 186.T: This (points at -1). | T: Haaibo jonga ngubani? *(Oh no, look who is this?)* | |
| 16:11 | | 187.Lv: Four, one. | | |
| | 07:09 | 188.Ln: It’s negative two. | T: Haaibo *(Oh no).* | |
| 16:15 | 07:10 | 189.Lz: It’s one. | | |
| | 07:11 | 190.Ln: (Raises her hand) I know, I know. | | |
| | 07:14 | 191.Lu: I know. It’s one. | | |
| 16:15 | | 192.T: (Looks at the other learners). | | |
| 16:16 | 07:15 | 193.Lz: It’s ten, zero. | | |
| 16:18 | | 194.T: (Shakes her head at Lz). | | |
| 16:18 | 07:15 | 195.Ln: (Raises her hand).I know it, I know. | | |
| | 07:15 | 196.Lu: It’s one. | | |
| 16:19 | 07:17 | 197.T: Come up (to Ln). | T: Yiza (*come*). | |
| 16:22 | 07:21 | 198.Ln: (Goes up to the board). | | |
| 16:23 | | 199.T: (To Lv—cannot see signing). Who, who? | T: Walk, walk, walk, walk. Finish, ewe (*yes*). Good. Ngubani? Ngubani? Ngubani, Nangamso? *(Who, who, who Nangamso?)* | |
| | 07:28 | 200.Ln: (Cannot see response). | Ln: Plus one. | |
| 16:32 | | 201.T: Write it there. | T: Bheka pha *(look there)*. | |
| 16:38 | | 202.Lv: I didn’t know it (returns to her desk). | | |
| 16:39 | | 203.Ln: (Writes on the board—cannot see written response). | | |
| 16:40 | | 204.T: Where is it? | T: Hayi (*no*). No. Uphi, uphi, uphi, uphi? *(Where, where, where?)* | |
| 16:46 | | 205.Ln: (points at number on number line—cannot see response) | | |
| 16:46 | 07:53 | 206.T: Who is it? | T: Hayi. Ngubani? *(No. Who?)* | |
| | | 207.Ln: (Cannot see response). | | |
| 16:51 | | 208.T: Who is it? (Shakes her head). | T: Hayi. Ngubani? *(No. Who?)* | |
| 16:53 | 07:51 | 209.Ln: Four. | Ln: Four. | |
| | 07:51 | 210.Lv: Minus one [*Learner produces required response*]. | | |
| | | 211.Lu: (Raises her hand) I know it. | | |
| 16:56 | | 212.T: (To Lv). Do you see it? You are sitting, do you see it? You are sitting, do you see it? (Gives the chalk to Lu). Who is it? | T: Uyayibona, ngoku? Xa uhleli…uyayibona ngoku? Ngubani? *(Do you see it now? When you are sitting? Do you see it now? Who?)* | |
| 17:07 | 08:05 | 213.Lu: (Gets up). It’s negative one. | | |

| | | | | |
|---|---|---|---|---|
| 17:08 | | 214.T: Do it there (points at Question 2c). | | |
| 17:11 | | 215.Lu: (Writes -1 following on from 3). | | |
| 17:14 | | 216.T: (Applauds). Thank you. Do you see? Do you see? (To Lb) Walk four from negative one. Let's see. | T: Good. Thank you. Siyabona, siyabona? Heke. Again, hamba kube kayi-four from minus one. Ndizakubona. *(Do you see? Do you see? Yes. Again, go four times from minus one. I will see).* | |
| 17:28 | 08:23 | 217.Lb: (Walks to the board). | |  Learner has produced the required response in the sequence. |
| 17:33 | | 218.T: (Ticks negative one) It walks four. | | |
| 17:37 | | 219.Lb: (Draws a line from -1 to -2). One. | | |
| 17:39 | | 220.T: (Nods). | | |
| 17:40 | | 221.Lb: (Draws a line from -2 to -3). | | |
| 17:44 | | 222.T: (Nods). | | |
| 17:45 | | 223.Lb: (Draws a line from -3 to -4) four. (Draws a line from -4 to -5). (Cannot see response). | | |
| 17:48 | | 224.T: Who, who? | | |
| | 08:46 | 225.Lv: Four. [*Learner's response is a whole number*]. | Ly: Four. |  Learner  walks" four times from -1 and "arrives" at -5 on the number line. |
| 17:51 | | 226.Lb: (Points at -4 on number line) Four. | | |
| 17:52 | | 227.T: Who arrives? Who? | | |
| 17:53 | | 228.Lb: It arrives here (Points at -4). | | |
| | 08:48 | 229.Lv: It's negative five, negative five. | | |
| | 08:48 | 230.Ln: With, with, with. | | |
| | 08:53 | 231.Lz: (Raises her hand) Five, five. | | |
| | 08:56 | 232.Lu: It's one. I know, it's one. | | |
| 17:54 | | 233.T: It arrives at who? | | |
| 17:59 | | 234.Lb: Five. | | |
| 18:00 | | 235.T: Negative or positive. [*Sundering sign from numeral*]. | | |
| 18:01 | | 236.Lb: negative, negative. | | |
| 18:02 | | 237.T: Yes, do it there (refers to Q2c). | | |
| 18:07 | | 238.Lb: (Writes -5 following after -1). | | |
| 18:08 | | 239.T: Yes. Do you see? Do you see? The last one, the last one. Who will help with the last one? | | |
| | 09:15 | 240.Lz, Ln, Lu: (Raise their hands). | | |
| 18:17 | | 241.T: You (points at Lz). | | |
| 18:18 | 09:17 | 242.Lz: (Gets up from her seat). | |  Learner has written -5 following on from -1 in the sequence. |
| 18:18 | | 243.T: No, wait. You (to Ll). | | |
| 18:22 | | 244.Ll (Goes to the board). | | |
| 18:26 | | 245.T: (Marks -5 on the number line). | | |
| 18:31 | | 246.Ll: Here? (Points at -5). | | |
| 18:32 | | 247.T: To the next one, it walk, walk, walks. | | |
| 18:33 | | 248.Ll: (Draws a line from -5 to -6) One. | Ly: One. | |
| 18:35 | | 249.T: (Nods). | | |
| 18:36 | | 250.Ll: (Draws a line from -6 to -7) Two. | Ly: Two. | |
| 18:38 | | 251.T: (Nods). | | |
| 18:39 | | 252.Ll: (Draws a line from -7 to-8) Three. | Ly: Three. | |

| | | | | |
|---|---|---|---|---|
| 18:40 | | 253.T: (Nods). | | |
| 18:42 | | 254.Ll: (Draws a line from -8 to -9) Four. | Ly: Four. | |
| 18:43 | | 255.T: Who is it? You arrived at who? | | |
| 18:45 | | 256.Ll: One, four. [*Learner has not acquired the criteria for using a number line to complete the sequence*]. | |  Learner “walks” four times from -5 to -9. The integers on the number line are quite small and may not be visible to all the learners. |
| 18:46 | | 257.T: (Appears surprised). | | |
| 18:47 | 09:47 | 258.Lz: It’s nine, nine. | | |
| | 09:47 | 259.Lv: Negative nine. | | |
| | 09:47 | 260.Lb: Nine. [*Learners consider integers as whole numbers*]. | | |
| | 09:49 | 261.Lu: (Raises her hand and tries to get teacher’s attention) I know, it’s zero. | | |
| 18:50 | | 262.T: Who did you arrive at? | | |
| 18:51 | | 263.Ll: Nine. | Ll: Nine. | |
| 18:52 | | 264.T: What is the heading? Positive or negative? Which one? [*Teacher sunders sign from numeral*]. | | |
| 18:55 | | 265.Ll: Five, three. | | |
| | 09:53 | 266.Lz: Negative, negative, negative nine. | | |
| | 09:51 | 267.Lv: Negative nine, negative nine. | | |
| | 09:52 | 268.Ln: Negative, negative. | | |
| 18:58 | | 269.T: It walk, walk, walks… | | |
| 18:59 | | 270.Ll: Negative four. | | |
| 19:01 | | 271.T: It’s finished, finished, finished where? Who is that? (Points at the board). | | |
| 19:03 | | 272.Ll: (Points at -9) it’s nine, negative nine. | | |
| 19:05 | | 273.T: Write it there. | | |
| | 10:04 | 274.Ln: It’s true. I said negative nine. | | |
| 19:09 | | 275.Ll: (Writes 10 following -5). [*Learner signed the required response but did not produce the required response in writing*]. | | |
| 19:10 | | 276.T: (Claps her hands together). Is it true? | | |
| | 10:09 | 277.Lv: Negative nine. | | |
| | 10:10 | 278.Ln: Negative, negative. | | |
| | 10:12 | 279.Lu: (Raises her hand). | | |
| 19:17 | | 280.T: (Erases the answer written by Ll. She looks at the learners) Who? Who? | | |
| | 10:18 | 281.Lz, Lv: Negative nine, negative nine. | | |
| | 10:19 | 282.Ln: He’s wrong, it’s negative nine. | | |
| | 10:18 | 283.Lu: Negative, zero, zero. | | |
| 19:23 | | 284.T: It arrived at who? (looks at Ly) It arrived at who, Yongama? It arrived at who over there? (Points at the board). | T: Ifika kubani? Ifika kubani, Yongama. Ifika ngubani pha? *(It arrived at who? It arrived at who, Yongama. It arrived at who over there?)* | |
| 19:26 | 10:24 | 285.Ly: Negative four. | | |

| | | | | |
|---|---|---|---|---|
| 19:27 | 10:25 | 286.T: Go up. | T: Huh? | |
| 19:29 | 10:27 | 287.Ly: Negative four. | | |
| 19:31 | 10:28 | 288. | T: Haaibo! *(Oh no!)* | |
| | 10:30 | 289.Lv: Negative nine. | | |
| | 10:32 | 290.Lz: Negative eight, negative eight. | | |
| | 10:32 | 291.Ln: I know. It's negative… | Ln: Nine, nine. | |
| | 10:32 | 292.Lu: Zero, negative zero, five, negative five. | | |
| 19:36 | | 293.T: You (To Lz), go up. | | |
| 19:37 | 10:34 | 294.Lz: (Gets up from her seat). | | |
| 19:40 | | 295.T: (Stands at the number line on the board. Points from -5 to -6) it's one. (From -6 to -7) it's two. (From -7 to -8) it's three. (From -8 to -9) it's four. It arrived at who? Who? Who? | T: Hey u-one. U-one (*One, one*). One, two, three, four. Ngubani? Ngubani? (*Who, who?*) | |
| | 10:46 | 296.Lv: Negative nine. | | |
| | 10:46 | 297.Ln: Nine negative, negative. | Ln: nine, nine. | |
| | 10:48 | 298.Lu: Nine. | |  |
| 19:50 | | 299.T: (To Lz) Write it. | | |
| 19:54 | | 300.Lz: (Writes -8 following -5). | | |
| 20:00 | | 301.T: (Looks and claps her hands together) Is it true, true, true? | T: Nyani, nyani, nyani? *(Is it true, true, true?)* | |
| 20:04 | | 302.Lz: Nine, negative nine. | | Learner has written -8 following on from -5 in the sequence. |
| 20:04 | | 303. | T: Ngoku why ubhala u-eight? *(Now why did you write 8?)* | |
| 20:06 | | 304.Lz: (Erases 8 and writes 9). | | |
| 20:11 | | 305.T: (Applauds). It's finished. | T: Finish. Now ke ngoku *(now, then)*. |  Learner erases 8 and writes 9 next to the negative sign. |

**<u>Criteria with reference to the number line:</u>**

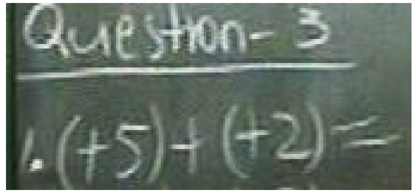
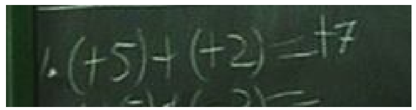
- Criteria for using the number line were implicit.
- The teacher did not explicitly show that the operation between the integers in the sequence was to subtract 4 or add -4.

**<u>Comments</u>:**

Learners required the teacher's assistance to use the number line. Learners produced required responses in signing but not in writing. Learners as a group were called on to produce the solutions.

## Evaluative Event 3: Addition of integers through four worked examples

### Evaluative Event 3.1: Two positive integers $+5$ and $+2$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 20:14 | | 306.T: Quickly, quickly, quickly, let's finish the last one (points at question 3). Remember, to make plus, plus, plus. [Teacher indicates the operation is addition]. Do you remember? | T: Quick, quick, quick, quick. Siza ufinisha *(We will finish)*. Finish, finish quick, quick, quick. Remember, remember sayenza *(we did)* plus, plus, plus, plus. Uyakhumbula? *(Do you remember?)* | <br><br>Question 3 of homework exercises. |
| 20:23 | 11:22 | 307. | Ln: Ewe (*Yes*). | |
| 20:26 | | 308.T: (Points at +5 of no. 1) plus five (points at +) plus two is who? | T: Heke. Now, plus five, plus two ngubani? *(Yes. Now, who is plus five plus two?)* | |
| | 11:25 | 309.(Some learners repeat question with teacher). | | |
| | 11:31 | 310.Lb, Lz: Seven. | Lb: Seven. | |
| 20:33 | | 311.T: What is it? Plus or minus? What is it? | T: Unjani? Plus, minus, unjani? *(How is it? Plus, minus, how is it?)* | |
| | 11:33 | 312.Lu: Seven. | | |
| | 11:33 | 313.Lb: Plus, plus. | | |
| 20:36 | | 314.T: (To Lb) Come up. | | |
| | 11:36 | 315.Lb: (Goes to the board). | | |
| 20:38 | | 316.Ll: It's plus seven. | | |
| | | 317.Lb: (cannot see his signing). | | |
| 20:45 | 11:46 | 318.T: Write it there. | | |
| 20:48 | | 319.Lb: (Writes +). | | |
| 20:49 | | 320.T: And? | | |
| 20:50 | | 321.Lb: (Cannot see his signing). | | |
| 20:51 | | 322.T: That's it. | | |
| 20:51 | | 323.Lb: (Writes 7). | | <br> |
| 20:52 | | 324.T: That's it. Do you see it's right, right. (Points at +5 and +2) what does it say? They are the same. What does it say? They are the same. There is no problem. There is no problem because what does it say? It is the same. | T: Heke. Uyayibona? U-right, right. Because ezi zitheni? Ziyafana. Zitheni? Ziyafana. Problem ayikho, né? i-Problem ayikho because zitheni? Ziyafana. *(Yes. Do you see it? You are right, right. Because these are what? They are the same. What are they? The same. There is no problem. There is no problem because? They are the same).* | A learner produced the required response of +7. |
| | 11:58 | 325.(Some learners repeat what teacher is saying). | | |

**<u>Criteria for adding two positive integers</u>:**

- There is no problem because they are the same. It is implicit that the teacher is referring to the numbers as being the same because they are both positive integers.
- Add positive integers as whole numbers.

**<u>Comments</u>:**

Learners were able to produce the required response of +7.

## Evaluative Event 3.2: A positive and negative integer: +5 and -2

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 21:11 | | 326.T: (Points at +5 and -2 of no. 2). Is there a problem here? | T: Okay. Problem ikhona? *(Is there a problem?)* |  Teacher refers learners to example 2 of question 3. |
| | 12:14 | 327.Lz, Lv: There is nothing. | | |
| 21:16 | | 328.Ll: (Response not recorded). | | |
| | 12:16 | 329.Lu: Five, seven, five. [*Learner seems to be adding the integers +5 and -2 as whole numbers*]. | | |
| 21:19 | | 330.T: He says (points at no.2) plus five, plus[18] with minus two. What is the answer[19]? | T: Uza wuthini ke ngoku? Plus five né umdibanise no minus two. Ngubani i-answer? *(What are you going to say now? Plus five added to negative two, who is the answer?)* | |
| | 12:26 | 331.Lz: One. | Lz: One. | |
| | 12:27 | 332.Lu: Three. | | |
| | 12:27 | 333.Ln: Three, four. [*Learners seem to be guessing*]. | | |
| 21:29 | | 334.T: Here (points at +5) plus five meets with who? Minus two. Who is the answer? | T: Apha, plus five né umdibanise nabani? No-minus two. I-answer ngubani? *(Here, plus five is added to who? Minus two. Who is the answer?)* | |
| | 12:39 | 335.Ln: Four. | | |
| | 12:35 | 336.Lu: Five. | | |
| | 12:39 | 337.Lb: Three. | | |
| | 12:38 | 338.Lz: One. | | |
| 21:41 | | *339.*T: (Points at Lb). [*Teacher calls on learner who has produced the absolute value of the required response].* | | |
| | 12:40 | 340.Lb: Three (gets up from his seat). | | |
| 21:42 | | 341.T: Wait, always, always you. Someone else. | T: Huh uh, yima ke not qho, qho, qho omnye *(Wait then, not always, always, always, always you, someone else).* | |
| | 12:44 | 342.Lz: One. | | |
| | 12:44 | 343.Ln: Four. | | |
| | 12:44 | 344.Lv: Two. | | |
| | 12:46 | 345.Ln: Six. | | |
| | 12:45 | 346.Lu: Plus seven…, five. [*Learners continue to guess*]. | | |
| 21:50 | | 347.T: Plus five meets who? Minus two. Who is the answer? | T: Plus five, né simdibanisa nabani? No-minus two. I-answer ngubani? *(Plus five added with who? Minus two. Who is the answer?)* | |
| | 12:50 | 348.Ll: (To Lb) Is it negative three, negative three? [*Learner has produced the correct response*]. | | |
| | 12:53 | 349.Lb: I won't tell you. | | |
| 22:00 | 12:58 | 350.Lu: Five. | | |
| 22:00 | 12:58 | 351.Ln, Lv: One. | | |
| 22:01 | | 352.Lz: Five, four. | | |

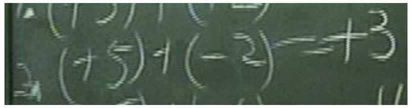
[18] Teacher uses incorrect sign for "plus" throughout the events where the operation is addition.
[19] Teacher uses sign for "report" instead of the sign for "answer".

| | | | | |
|---|---|---|---|---|
| 22:04 | | 353.T: You (to Ll) put your book down. | T: Hmm? Bek'incwadi phantsi *(Put the book down).* | |
| 22:07 | | 354.Ll: Minus three. | | |
| 22:09 | | 355.T: Maybe… | | |
| 22:10 | | 356.Lz: It's one. | | |
| | 13:10 | 357.Ll: Negative five. | | |
| 22:12 | | 358.T: (Points at Ll) Three yes, it's right. Three plus maybe but I agree that you say negative three. | T: U-three ewe u-right three, three i-right but andivumi xa usithi minus three *(Three yes three, three is right but I don't agree when you say minus three)*[21]*.* | |
| | 13:14 | 359.Lv: Minus four, minus four. | | |
| 22:20 | 13:18 | 360.Lz: Minus one. | | |
| 22:23 | | 361.T: What do you all say? (Looks at the learners for a response). Who? Who? | | |
| | 13:24 | 362.Lv: Minus four. | | |
| 22:29 | 13:26 | 363.Lz: Minus five, plus five… | | |
| | 13:30 | 364.Lu: Two, minus three. | | |
| | 13:30 | 365.Lv: Minus six, minus six. | | |
| 22:35 | | 366.T: What do you say (to Ll)? | | |
| 22:37 | | 367.Ll: Negative… | | |
| 22:37 | | 368.T: We said plus five meets[20] who? Minus two. Remember I said when they are different which sign must you take? Take which sign when they are different? What did I say? What did I say? | T: Hmm? Sithi kaloku plus five dibanise nabani? No-minus two. Remember, remember sasitheni xa zingafani, xa zingafani sithathe i-sign eyiphi? Sithatha i-sign eyiphi xa zingafani? Sasitheni, sasitheni, sasitheni? Heh? *(We said positive five plus who? And minus two. Remember, what did we say when they are not the same, they are not the same. We take which sign? We take which sign when they are not the same. What did we say; what did we say; what did we say?)* | |
| | 14:00 | 369.Lu: Seven. | | |
| | 14:01 | 370.Ln: Eight, negative… | | |
| 23:04 | | 371.T: If, if the numbers (tries to get their attention. Looks at Ly who is looking in his book) Close it. Remember, I said if, if the numbers are different, the signs are different, which one do we take? Positive which? | T: If, if i-nambas… Yongama vala incwadi. Remember sasitheni if, if inamba azifani, i-sign azifani sawuthatha eyiphi i-sign? *(If the numbers… Yongama, close the book. Remember, what did we say if the numbers are not the same, if the signs are not the same which sign will we take?)* | |
| | 14:19 | 372.Lv: Six. | | |
| | 14:21 | 373.Lz: Positive. | | |
| | 14:20 | 374.Lu: Five. | | |
| 23:25 | | 375.T: Remember, now we are working with big and small. | T: Hello, remember now siwork(a) *(we work)* with big and small. Andithi *(didn't I say?)* | |
| | 14:29 | 376.Lv: Negative seven. | | |
| 23:32 | | 377.T: Now, which (points at +5 and -2) which one is big? [*Learners need to consider 5 and 2 as whole numbers*]. | T: Now, apha kwezi zi-two yeyiphi e-big? *(Now, here of these two which one is big?)* | |



[20] Teacher is referring to the operation of addition.
[21] There is a discrepancy between the teacher's signing and spoken language.

| | | | | |
|---|---|---|---|---|
| | 14:33 | 378.Lv: Negative seven. [*Learner adds integers as whole numbers*]. | | |
| 23:37 | | 379.T: Who is big? | T: Ngubani…omkhulu? *(Who is big?)* | |
| 23:37 | 14:37 | 380.Ll: Five is big, five is big. | | |
| | 14:37 | 381.Lz: Minus, minus | | |
| 23:38 | | 382.T: Who? | T: Ngubani? *(Who?)* | |
| 23:38 | 14:38 | 383.Ll: Five is big. | | |
| | 14:43 | 384.Lb: Six. | | |
| 23:40 | | 385.T: Five with sign. What is before, before five? | T: Five with … before, before u-five ngubani lo? *(Who is this before five?)* | |
| | 14:43 | 386.Ln: Plus. | | |
| | 14:43 | 387.Lv: Seven. | | |
| | 14:49 | 388.Lz: Plus. | | |
| 23:46 | | 389.T: (Points at Lz) That's it. (Writes +). Now, what do we say? Now? | T: Plus. Né, heke. Now, sithini ke ngoku? Sithini? *(Yes. What do we say now, What do we say?)* |  Teacher writes + following the equality sign. |
| | 14:51 | 390.Lv: Seven. | | |
| | 14:51 | 391.Lz: One. | | |
| | 14:52 | 392.Ln: Eight. | Ln: Eighty. | |
| | 14:54 | 393.Lu: Five. | | |
| 23:56 | | 394.Ll: Five. | Ll: Five. | |
| 23:57 | | 395.T: What is five saying? | T: Five simthini? *(What must we do with five?)* | |
| | 14:57 | 396.Lb: Negative or positive? | | |
| | 14:57 | 397.Lz: Positive one, positive one. | | |
| | 14:58 | 398.Ln: Six, positive six… | | |
| | 14:59 | 399.Lv: Seven. | | |
| 24:03 | | 400.T: (Looks at Lz then looks at the other learners). | | |
| 24:10 | | 401.Ll: Positive three. | | |
| 24:12 | | 402.T: That's it (points at Ll). He says plus three. [*Teacher calls on learners who produce the required responses*]. Remember, I said if they are the same, take the sign of the big one. Which means five is big. Five says it's big. Five is saying? It's big. Who is before five? Plus or minus? Who? | T: Ya, uthi plus three. Ewe, remember sasitheni. If azifani né siza uthatha né i-sign ye-big. Which means u-five u-big, né. U-five utheni? U-big, né. U-five utheni? u-Big, né. Before, before five ngubani? Plus or ye-minus ngubani? *(He says plus three. Yes, remember what did we say? If it's not the same, we take the sign of the big number. Which means five is big. Five is what? It's big. Five is what? It's big. Who is before five, plus or minus who is it?)* | |
| | 15:38 | 403.Ln, Lb: Plus. | Ln: Plus. | |
| 24:41 | | 404.T: Plus finish. It says five take away two, how much is left? [*Teacher's language use is as for subtraction. Subtract the small number from the big number*]. | T: Plus. Sawuqgiba sithini? Sithi five susa two, kushiyeka bani? *(When we finished what do we say? We say five take away two, who)* | |
| | 15:46 | 405.Ln: Five, two. | Ln: Five, two. | |
| | 15:46 | 406.Lu: Three, two. | | |
| | 15:48 | 407.Lz: Two. | | |
| 24:50 | 15:48 | 408.Lv: Five. | | |
| 24:50 | | 409.T: Five minus two, who is left? | T: u-Five thabathe u-two shiyeka bani? *(Five take away two, how much is left?)* | |
| | 15:51 | 410.Lz: Plus. | | |

| | | | | |
|---|---|---|---|---|
| | 15:51 | 411.Lv: Three. | | |
| | 15:51 | 412.Ln: Two. | | |
| | 15:51 | 413.Lu: Three is left, three is left. | | |
| 24:54 | | 414.T: That's it (points at Lu). | T: Kushiyeka three *(three is left).* | |
| | 15:55 | 415.Lu: I knew it. | | |
| 24:59 | | 416.T: (Writes 3) He said it. L (refers to Ll) said it. Plus three. It's true. | T: KuShiyeka three. Utshilo uLeonardo. uLeonardo utshilo. Wathi uza kuba ngu-plus three. Unyanisile. *(Three is left. Leonardo said it. Leonardo said it. He said it will be plus three. He is right.)* |  The teacher writes 3 next to the + sign. |
| | 16:05 | 417.Lu: I knew three is left | | |
| 25:09 | | 418.T: That's right. | T: Ewe (*Yes*). | |

**Criteria for adding a positive and negative integer:**

- If the signs are different, the numbers are different. It is implicit that positive and negative integers are different.
- If the signs are different, consider the "big" number. Here, the teacher's use of "big" requires that the integers be considered as whole numbers.
- Take the sign of the "big" number.
- The solution will have the sign of the "big" number.
- Subtract the "small" whole number from the "big" whole number.
- The solution of the whole number calculation is written next to the sign of the "big" number in the solution.

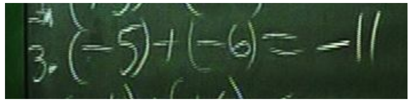
**Comments:**

Learners guess the solutions and call out answers as they have not acquired the teacher's implicit criteria for adding a positive and negative integer. The teacher does not provide the learners with feedback as to why their responses are incorrect. She calls on learners who produce the correct response.

### Evaluative Event 3.3: Two negative integers: $-5$ and $-6$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 25:09 | | 419.Now, (points at -5 and -6 of no. 3). Who is it? | T: Now, apha *(Now, here*). |  The teacher refers the learners to example 3 of Question 3. |
| | 16:12 | 420.Ln: Minus five plus minus six. | | |
| 25:16 | | 421.T: Minus five, minus five meets who? Minus six. Who is it? | T: Minus five, né, minus five simdibanise nabani? No-minus six. Iza kuba ngubani? *(Minus five plus who? And minus six? What is it going to be?)* | |
| | 16:25 | 422.Lz: Six. | | |
| | 16:25 | 423.Ln: Minus, minus. | | |
| 25:28 | | 424.T: (Looks at Ln) It's minus (writes -). Minus what? | T: Ewe, minus unyanisile. Minus ntoni ke ngoku? *(Yes, minus is correct. Minus what now?)* | **3.** $(-5) + (-6) = -$ |
| 25:34 | 16:31 | 425.Lz: Six is left, minus six is left, minus six. | | |

| | | | | |
|---|---|---|---|---|
| 25:38 | | 426.T: Minus five plus minus six is who? (To Ln) Yes, you said it, you said minus. | T: Minus five simdibanise no-minus six. Ngubani? Unyanisile, Nangamso. Uthe minus *(Minus five plus minus six. Who is it? You are right, Nangamso. You said minus).* | |
| 25:45 | | 427.Ll: Minus one, minus one. | | |
| 25:46 | | 428.T: No. | | |
| | 16:44 | 429.Lz: Minus two. | | |
| | 16:45 | 430.Lv: minus two, minus six. | | |
| | 16:45 | 431.Ln: Four, minus five? | Ln: Minus five. | |
| 25:48 | | 432.T: Remember, remember I said if it is the same, is there a problem? | T: Remember, remember besithe if ziyafana iproblem ikhona? *(Remember, we said if it's the same, is there a problem?)* | |
| | 16:51 | 433. | Ln: Hayi (*No*). | |
| 25:55 | | 434.T: There is not. When it is the same, do we say there is a problem? There is not. If it is the same, there is no problem. It says add, add, add. It says add, add, add. We take the sign of who? Minus because we said it is the same. It says there is no problem. Now, we say five plus six is who? | T: Ayikho. Xa zifanayo iproblem itheni? Ayikho, né. If ziyafana iproblem itheni? Ayikho. Siyathini ke ngoku? Siyazidibanisa. Siyazithini? Siyazidibanisa, né. Siza wuthatha la-sign ngubani? Ingu-minus because itheni? Ziyafana. Iproblem itheni? Ayikho, né. Now, uza wuthi kengoku five plus six ngubani? *(There is not. When they are the same, is there a problem? No problem. If they are the same the problem is what? No problem. What do we do now? We add them together. What do we do? We add them. We will take that sign, which sign? It's minus. Because why? They are the same. The problem is what? No prob. Now, you are going to say five plus six is who?)* | |
| 26:26 | | | Ly: Five. | |
| | 17:22 | 435.Lu, Lv: Five, five. | | |
| | 17:23 | 436.Ln: Two. | | |
| | 17:24 | 437.Lz: Seven. | | |
| 26:27 | | 438.T: Who is five plus six? | T: Five dibanise no-six ngubani? *(Who is five plus six?)* | |
| | 17:28 | 439.Ln: Two. | | |
| 26:30 | 17:28 | 440.Lz: Eight. | | |
| | 17:29 | 441.Lu: Eleven. | | |
| 26:32 | | 442.T: (To Lu) don't tell. Five, don't tell (To Lu). Five plus six is who? | T: u-Five, five simdibanise no-six ngubani? *(Five plus six is who?)* | |
| | 17:37 | 443.Lz: Six. | | |
| | | 444.Ll: Eleven | | |
| 26:42 | | 445.T: (Tries to get Ly's attention) who is five plus six? | T: Yongama, five dibanisa no-six ngubani? *(Yongama, five plus six is who?)* | |
| 26:45 | | 446.Ly: I don't know | | |
| 26:46 | | 447.T: Count, count, count. You don't want to. You are lazy. Who is five plus six? | T: Hayi, bala Yongama suveluthi awuyazi. Awufuni. Uyonqena wena. Five dibanisa u-six ngubani, Yongama? *(No, count, Yongama don't just say you don't know it. You don't want to, you are lazy.* | |
| 26:56 | | 448.Ly: Eight. | | |
| 26:58 | | 449.T: Count it. | T: Huh? Awufuni ucinga wena. Dibanisa, Yongama. *(You don't want to think. Add, Yongama.)* | |
| 26:59 | | 450.Ly: (Does not respond). | | |

| | | | | |
|---|---|---|---|---|
| 27:09 | | 451.T: Five plus six is who? | T: Five dibanisa six ngubani? *(Five plus six is who?)* | |
| 27:10 | | 452.Ly: (Does not respond). | | |
| 27:16 | | 453.T: You (to Lz). | | |
| | 18:15 | 454.Lz: Eleven. | |   The solution is a negative integer. |
| 27:18 | | 455.T: Good. (Writes 11). | T: Ewe, heke *(yes).* | |
| | 18:18 | 456.Ly: She said it, she said it (Points at Lu) | | |
| 27:23 | | 457.T: I said minus five meets who? Minus six is who? Minus eleven. | T: So, apha sithe minus five simdibanise nabani? Minus six. Sifumana bani? U-Minus eleven. *(So, here we said minus five plus who? Minus six. We get who? Minus eleven).* | |
| | 18:34 | 458.Lu: I knew it. | | |
| 27:37 | | 459.T: Here (points at no. 3) there is no problem because minus and minus is the same as who? Minus. | T: Apha, iproblem ayikho because minus and minus iyafana nabani? Minus. Né? Siyavana? *(Here, there is no problem because minus and minus is the same as who? Minus. Do you agree?)* | |
| | 18:47 | 460.Ln, Lu: (Nod). | | |

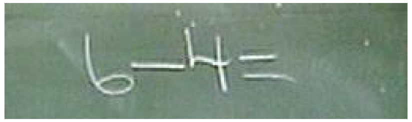
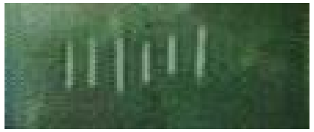
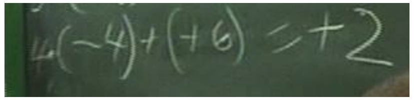
**<u>Criteria with reference to adding two negative integers</u>:**

- The solution will have a negative sign. Write the negative sign after the equality sign.
- Consider the integers as whole numbers.
- Add the whole numbers.
- Write the solution of the whole number addition next to the negative sign.

### Evaluative Event 3.4: A positive and negative integer: $-4$ and $+6$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 27:52 | | 461.T: Here (points at no. 4). Minus four plus, meets who? Plus six. Who is it? | T: Apha, minus four plus simdibanise nabani? No-plus six. ngubani? *(Here, minus four plus add who? And plus six. Who is it?)* |   |
| 28:02 | | 462. | Ln: Plus. | |
| | 18:59 | 463.Ln: Plus, plus, plus. | | Teacher refers learners to example 4 of Question 3 |
| | 18:59 | 464.Lu: ten, ten, ten, ten. I know it, I know it. [*Learner is adding the integers as whole numbers*]. | | |
| 28:02 | | 465.T: First, yes, plus! (Writes +). Who is it? | T: First…heke plus oh! Umntwanam. Uyayazi. Plus ngubani ke ngoku? *(Yes, plus oh! My child. You know it. Plus who now?)* | |
| | 19:07 | 466.Lu: Ten, ten, ten. | |   |
| 28:12 | | 467.T: Plus is true because you take what sign? The big number. Which plus six is saying. It's big. Who? Minus four. What does the last one say? | T: Plus unyanisile because sithatha, sithatha i-sign ngantoni? Yenamba e-big. Which means u-plus six utheni? U-Big. Kunabani? Kuno-minus four, né? Sawuqgiba ke ngoku sithini? *(Plus is right because we take we take the sign of what? The big number. Which means plus six is what? It's big. Than who? Than minus four. When we are finished now what do we do?)* | Teacher has written + as the solution. |
| | 19:30 | 468.(Learners are thinking and counting on their fingers). | | |
| | 19:36 | 469.Lz: Ten? [*Learner is doing whole number addition*]. | | |
| | 19:37 | 470.Lv: One, two, positive… | | |
| 28:43 | | 471.T: Remember, I said if it is the same, take…Remember | T: Remember, ndithe if azifani sithatha remember ndithe if azifani, né | |

| | | | | |
|---|---|---|---|---|
| | | I said if it is the same, take the sign of the number saying it's big. When that's done, minus. Which means now we are saying six minus who? Six minus who? | sithatha i-sign yenamba etheni? e-big. Sawuqgiba sithini? Sithabathe, né. Which means now siza uthi six susa bani? Six minus bani? *(Remember, I said if it's not the same we take remember I said if it's not the same we take the sign of what number? The big one. When we finished, we do what? We minus. Which means now we will say six take away who? Six minus who?)* | |
| | 20:10 | 472.Lu: Four. | | |
| | 20:10 | 473.Ln: Leaves…six… | | |
| | 20:10 | 474.Lv: Six. | | |
| 29:13 | | 475.T: Four. Who is left? | T: Four. Kushiyeka bani? *(Who is left?)* | |
| | 20:13 | 476.Ln: Six. | | |
| | 20:13 | 477.Lu: Six is left, six is left. | | |
| 29:17 | | 478.T: No. | | |
| | 20:16 | 479.Ln: Four? | Ln: Four? | |
| 29:20 | | 480.T: Six minus four. Who is left? | T: six, né minus four… | |
| 29:26 | 20:23 | 481.Lz: Three. | | |
| | 20:23 | 482.Lv: Six is left. | | |
| | 20:23 | 483.Ln: Six… Four, four. | Ln: Four. | |
| | 20:24 | 484.Lu: Four. | | |
| 29:27 | | 485.T: You don't know how to count. | | |
| | 20:26 | 486.Ln: Four. | Ln: Four, four. | |
| | 20:26 | 487.Lz: Two. | | |
| | 20:26 | 488.Lu: Four. | | |
| | 20:26 | 489.Lv: Six is left. | | |
| 29:30 | | 490.T: Six minus four is who? | | |
| 29:36 | 20:33 | 491.Lz: Four. [*Learners are unable to do simple arithmetic*]. | | |
| 29:36 | | 492.T: What? | | |
| 29:37 | 20:35 | 493.Lz: Six. | | |
| | 20:37 | 494.Lu: Nought. | | |
| | 20:37 | 495.Lb: Two. | Lb: Two. | |
| 29:39 | | 496.T: Six… (To Lb) don't tell. Six minus four, who is left? | | |
| | 20:41 | 497.Lb: I know it, I know. | | |
| | 20:43 | 498.Lz: Six….four? | | |
| | 20:44 | 499.Lv: Six is left. | | |
| 29:54 | | 500.T: Six minus four. | T: Haaibo, hayi, hayi *(Oh no, no, no)* | |
| | 20:49 | 501.Lz: Six. | | |
| | 20:51 | 502.Ln: Seven. | | |
| | 20:52 | 503.Lv: Six is left. | | |
| | 20:52 | 504.Lu: Ten, ten. Ten minus six. | | |
| 30:00 | | 505.T: Six minus four, who is left? | | |
| 30:05 | 21:01 | 506.Ln: Four. | Ln: Four. | |
| | 21:01 | 507.Lv: Four is left. | | |
| | 20:59 | 508.Lu: Six. | | |
| | | 509. | T: Hmm? | |

| | | | | |
|---|---|---|---|---|
| | 21:04 | 510.Ln: Four. | Ln: Four. | |
| | 21:04 | 511.Lu: Six is left. | | |
| | 21:05 | 512.Lz: Plus. | | |
| 30:06 | | 513.T: (Writes 6-4 =) | T: Six minus four zenze bani? *(Six minus four makes what?)* | <br>Subtract the small number from the big number. |
| | 21:15 | 514.Lb: I know it. | | |
| 30:18 | | 515.Ll: Two. | | |
| 30:18 | | 516.T: (To Lb) Yes, leave it. (To Ll) wait, wait. You (points at Ly). Father, who is it? | T: Tata, ngubani? *(Father, who is it?)* | |
| | 21:23 | 517.Lu: (Tries to get teacher's attention). It's two. I know it, I know it. | | |
| 30:30 | | 518.T: (Looks at Lz). | | |
| 30:40 | | 519.Lz: (Counting on her fingers) eighty, eighty, eighty. | | |
| 30:47 | | 520.T: (Walks away and goes to Ln). | T: Ebengakwazi ukubala *(He didn't know how to count)* | |
| 30:50 | | 521.Ln: (Does not respond). I don't know. | | |
| 30:50 | | 522. | T: Nangamso, haaibo, Nangamso. Hayi, Nangamso, Hayi, Nangamso ulibele bethuna *(Oh no, Nangamso. No, Nangamso. No, Nangamso forgot shame).* | |
| | 21:51 | 523.Lu: It's two. | | |
| 31:08 | | 524.T: You (Points at Lv). | | |
| 31:09 | | 525.Lv: (Response not recorded). | | |
| 31:10 | | 526. | T: Yho! | |
| 31:11 | | 527.Ln: Five. | Ln: Five. | |
| 31:13 | | 528.T: (Draws six lines on the board). Now, take two, take four. How many are left? | T: Hebethuna nantsi, jongani. Ezi zi-one, two, three, four, five, six, né. Now, uthathe zibeyi-two, zibeyi beyi-four kwakushiyeka zibe ngaphi? *(Listen here, look here these are… Now, you take two, four, how much is left?)* | <br>Teacher has drawn six lines to simplify the arithmetic. |
| 31:27 | 22:24 | 529.Lv, Lz: Two. | Ly: Two. | |
| | 22:26 | 530.Lu: Two. | | |
| | 22:30 | 531.Ln (Seems confused). | | |
| 31:27 | | 532.T: That's it. (Writes 2 at no. 4). Do you see? Was it difficult or easy? | T: Bendifuna kude kwenziwe lo nto. Nantsoke, siyabona? Kunzima okanye kulula? Kunzima or ilula? *(That's what I wanted. There we are, do you see? Is it difficult or easy? Difficult or easy?)* | <br>Teacher writes 2 next to the positive sign. |
| | 22:42 | 533.Lb: It's difficult. | | |
| | 22:45 | 534.Lz: It's easy. | | |
| 31:49 | | 535.T: It's easy but your problem is, you are not thinking. It's easy but your problem is you are not thinking. Again, I want adding. Please continue with it. Finish. | T: Ilula but i-problem nina anifuni kuthini? Cinga, né. Zilula but i-problem anifuni kuthini? Anifuni kuthini? Cinga, né. So, again kuzafuneka…ezi zidibanisayo siphinde ezithini? Siqhubekeke, né, né? Okay, finish, finish. *(It's easy but your problem is you don't want to do what? Think. It's easy but the problem is you don't want to do what? You don't want to do what? Think. So again, we will have to… these that add we must again do what? Continue.* | |

**Criteria:**

- Consider the integers as whole numbers.

- Take the sign of the big number. The solution will have the sign of the big number.
- Subtract the smaller whole number from the bigger one.
- Write the solution of the whole number computation next to the sign of the big number.

## Evaluative Event 4: Marking of problems given as homework

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 32:13 | | 536. I want to see your books. (She goes around the class looking at their work and marking it). | T: Khawume ndibone ke ezincwadini zenu *(It's easy but your problem is you don't want to do what? Think. It's easy but the problem is you don't want to do what? You don't want to do what? Think. So again, we will have to… these that add we must again do what? Continue. Please let me look in your books.)* | |
| 32:32 | | 537. T: Let me see (to Ll). (She looks at his book). | T: Heyyy… | |
| 32:42 | | 538. Ll: I need to erase that. | | |
| 32:46 | | 539. | T: Kange babale *(They never wrote).* | |
| 32:50 | | 540. T: (Goes to Ly, looks at his book then walks to Lz. She looks at Lz's work and marks it. She marks Lv's book). Who is this (to Lv)? | | |
| 34:13 | | 541. Lv: Forty seven. I understand. | | |
| 34:29 | | 542. T: (Marks Ln's work. Her cell phone rings and she answers it. She returns to continue marking Ln's work. She marks Lu's work. She takes Lb's book). | T: Lo, lo ndifuna ukubona ukuba uyenze njani *(this one, this one I want to see how she did it).* | |
| 35:51 | | 543. T: Wait, wait (to Ln). (She writes on the board) | T: Mamelani bhala i-corrections. Xa u-wrong, bhala i-corrections. *(Listen, write your corrections. When you are wrong, write corrections).* | |
| 36:10 | | 544. T: Write it on a clean page. Write all the same. | T: Bhala u- i-clean, bala same yonke. *(Write it on a clean page, write the same).* | |
| 36:14 | | 545. T: (She shows Lv where to write in her book. She then shows Lz). | T: Bhala i-corrections *(Write corrections).* | |
| 36:28 | 26:39 | 546. T: (Takes Ly's book and marks his work) Write here. (She marks Ll's work). | | |
| 36:48 | | 547. Ll: That's one. | | |
| 36:49 | | 548. T: (Marks Ll's work). Copy here (points at his book). All of that (points at the work on the board), the same. All of it. | | |
| 37:22 | | 549. T: (Marks Lb's work). | | |
| 38:24 | | 550. T: Quickly, quickly the time is finished. The time, the time. (To Ly) Write. You are only copying. Copy the same as that (points at the board) only. | T: Ixesha liza wuphela Ixesha liyaphela. Khawulezisa Yongama. Bhala. Kukopa qha. Kopa same, same, same. Yonke la nto qha. Quick. *(The time is going to be up. The time is up. Hurry up Yongama. Write. Copy only. Copy the same, same, same. All of that only).* | |
| 38:36 | | 551. T: (To Ln) all the same. No need to think, just copy. | T: Siyakopa ngoku qha same. Awuzucinga. Ukucinga akukho. Kopa qha. *(We are just copying now the same. No need to think. There is no* | |

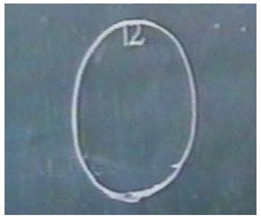
| | | | | |
|---|---|---|---|---|
| | | | *thinking, just copy)* | |
| 38:41 | | 552.T: (To Lb): Write. Everything the same. Sorry. | T: Bhala same yonke *(write all the same)*. Sorry. | |
| 38:53 | | 553.(The learners copy the work on the board into their books). | | |
| 40:43 | | 554.Lv: (Raises her hand) That side? (refers to work on second board). | | |
| 40:46 | | 555.T: Continue with it. | | |
| 41:10 | | 556.T: (Looks at Lu's work while she writes then looks at the other learners' work). | | |
| 41:46 | | 557.T: (Goes to Ly) It's small, quickly. | T: Yongama, bhala kancinci, man. Bala kancinci *(Yongama, write small, man. Write small)* | |
| 41:58 | | 558.T: (Looks at Ll's work) Why are you writing big and small there? | | |
| 42:08 | | 559.Ll: Here? (points at his page). | | |
| 42:09 | | 560.T: Yes. | | |
| 42:11 | | 561.Ll: (Continues to write). | | |
| 42:15 | | 562.T: Copy that only. Write that (points at the work on the board). | | |
| 42:18 | | 563.Ll: (Continues to write). | | |
| 42:37 | | 564.T: Do that (points at work on second board) here (points at his book). | | |
| 42:56 | | 565.(The bell rings to signal the end of the period). | | |
| 43:14 | | 566.T: The time is finished. Who is your teacher now? Who is your teacher now? | | |
| 43:23 | | 567.Lb: The police are downstairs. | | |
| 43:25 | | 568.T: Are the police downstairs? | | |
| 43:25 | | 569.Lb: (Nods). | | |
| 43:26 | | 570.T: Okay. All of you finish copying. The time is finished. Copy all of it. Thank you, thank you, thank you, thank you. Good. Thank you. Leave that on the board. Where are the police? Downstairs?<br>(End of Lesson Two) | T: Okay, siza kufinish… Uyayisha apha *(We will finish. We'll end here).* | |

# Appendix I: Transcript and Analysis of a Grade Five Lesson on Time

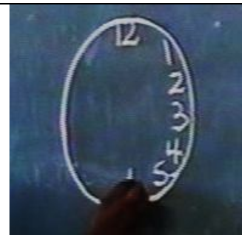
Symbols: T: Teacher's signing or speech
Lt, Lp, Lph, Ls, Lz, Lod, Lol, Lan, La: Individual learners' signing or speech
T-DVD: Time taken from the DVD which focussed on the teacher
L-DVD: Time taken from the DVD which focussed on the learners

## Evaluative Event 1: Describing the time using a clock

### Evaluative Event 1.1: The components of a clock

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 00:03 | | 1. T: Good. | | |
| 00:08 | | 2. T: Today we will learn about "Time". Do you know it from last year? Time, time, time (repeats). (Writes "Time" on the board). | |  |
| | 00:11 | 3. (Learners nod). | | |
| | 00:16 | 4. Lt: Twelve o' clock. I don't know. | | |
| | 00:19 | 5. Lp: I don't know. | | |
| | 00:22 | 6. Lph: Three, three. | | |
| | 00:26 | 7. Lz: I know. | | The topic is made explicit in writing. |
| | 00:27 | 8. Ls: Time. | | |
| | 00:27 | 9. Lt: Time. | |  |
| 00:26 | | 10. T: (Points at the word "Time"). That is time, time, time, time. | | |
| | 00:29 | 11. (The learners repeat time, time, time). | | |
| 00:34 | | 12. T: Ok. Now. (Writes on board). | | |
| | 00:49 | 13. (The learners chat amongst themselves while the teacher draws a clock). | | |
| 01:00 | | 14. T: (Points at 12) Who[22] is that? | | |
| | 01:00 | 15. Ls, Lt: Twelve, twelve, twelve. | Lt: Twelve. | |
| 01:02 | | 16. T: This? This? (Points at the space next to twelve). | | |
| | 01:02 | 17. Lp, Ls: One, one, one. | | Teacher fills in 12 on the clock. |
| | 01:03 | 18. Lt: One. | Lt: One. | |
| 01:06 | | 19. T: (Writes "1"on the clock). (Points at space below 1) | | |
| | 01:06 | 20. Lt, Ls, Lph, Lz: Two, two, two. | Lt: Two. | |
| 01:09 | | 21. T: (Writes "2" on the clock). (Points at space below 2). | | |
| | 01:09 | 22. Lp, Lt, Ls: Three. | Lt: Three. | |
| 01:11 | 01:12 | 23. (Learners continue to count to twelve while the teacher fills in the numbers on | | |

[22] Teacher uses the sign for "who" instead of "what" when referring to objects.

| | | | | |
|---|---|---|---|---|
| 01:35 | | the clock).<br>24. T: Do you see? Remember now. Now, remember the long hand and short hand that ticks away all the time (demonstrates a ticking movement with her hand)[23]. Do you know it? | | <br>Teacher fills in numbers on the clock.<br><br>Numbers from 1-12 are filled in on the clock. |

**Criteria:**

- Time is represented by a clock.
- The clock face consists of a domain of numbers from 1 to 12.
- The clock consists of hands which are tall and short and behave in a specific manner, i.e. they make specific movements.



### Evaluative Event 1.2: An example of describing the time: eight o' clock.

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 01:54 | | 25. Ok. Now, maybe an example. (Draws hands on the clock). | | |
| | 01:43 | 26. Lp: (nods uncertainly). Yes, the long one, the short one. | | |
| | 01:45 | 27. Ls: Short one. | | |
| | 01:53 | 28. Lt: Yes, I know it from before. | | |
| | 01:56 | 29. Lp: I don't know any of this. | | |
| | 02:08 | 30. (Some learners are chatting and joking). | | |

[23] The teacher uses incorrect signs for the long hand and short hand of the clock as well as when demonstrating how the hands tick. The signs used for "tall" and "short" are the signs used to describe the height of people and would not be used to describe an object.

| | | | | |
|---|---|---|---|---|
| 02:14 | | 31. T: Ok now, (points at one hand) the tall one stands at what? | |  The teacher provides an example of telling the time using the clock. |
| | 02:16 | 32. Ls: The tall one. | | |
| | 02:17 | 33. Lt, Ls, Lph, Lz: Twelve. [*The learner is able to state where the long hand is pointing*]. | Lt: twelve | |
| 02:24 | | 34. T: Yes, yes, yes. (Points at12). Yes, yes, yes. Twelve. (Points at hand on the clock). The short one stands[24] where? | | |
| | 02:19 | 35. Lt: The short one is at eight. | Lt: Eight, eight | |
| | 02:19 | 36. Ls: The short one is at eight. [*These learners know where the short hand points*]. | | |
| | 02:20 | 37. Lph: Ten. | | |
| | 02:22 | 38. Lz: Twelve. | | |
| | 02:23 | 39. Lol: The short one. | | |
| 02:33 | | 40. T: What is the time, time, time? | | |
| | 02:30 | 41. Lp: The short one, the time is eight, half in the afternoon. The time is eight half in the afternoon. | | |
| | 02:30 | 42. Ls: Eight. Time, time, time. To eight. | | |
| | 02:31 | 43. Lt: It stands for the time. Afternoon. Eight, half, eight, afternoon. | | |
| | 02:38 | 44. (A learner is at the door and distracts the learners). | | |
| 02:44 | | 45. T: The long one stands at what? | | |
| 02:47 | 02:46 | 46. Lp: Twelve. | | |
| | 02:46 | 47. Ls: Twelve. | Lt: Twelve | |
| | 02:48 | 48. Lt: Twelve. [*The learners are unable to state the time on the clock*]. | | |
| | 02:52 | 49. Lp: Close the door. | | |

**Criteria:**

- It is implicit that the numbers and the position of the hands are used to tell the time.

**Comments:**

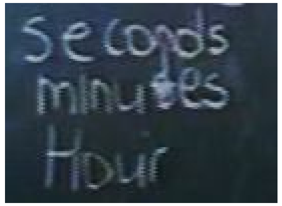
The learners are able to state at which numbers the hands are pointing but they are unable to tell the time.

## Evaluative Event 2: Describing the relationship between minutes, seconds and hours

### Evaluative Event 2.1: Comparing the terms seconds, minutes and seconds to the hands on a clock

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 02:49 | | 50. T: Remember I said… Now I want to know… (Writes seconds, minutes and | | |

[24] The sign for "stand" is used to indicate people standing.

| | | | | |
|---|---|---|---|---|
| | | hour on the board). | | |
| | 03:06 | 51. (Learners chat amongst themselves). | |  The terms written by the teacher. |
| 03:12 | | 52. T: Now, now I want you to choose this (points at hand at twelve on clock). stands where? (Points at the three words on the board). Where? | | |
| | 03:18 | 53. Ls: Twelve. | | |
| | 03:19 | 54. Lt: H-H-H[25]. | | |
| | 03:20 | 55. Lph: Twelve, M. | | |
| | 03:21 | 56. Ls: S, M | | |
| 03:19 | 03:25 | 57. Lp: S. | | |
| 03:23 | | 58. Lp: (Attempts to fingerspell “minutes”). | | |
| 03:25 | | 59. T: The tall one stands where? | | |
| 03:25 | 03:26 | 60. Lt: Twelve, twelve, twelve. | | |
| 03:30 | | 61. T: (Points at the word “seconds”). Where? | | |
| | 03:34 | 62. Lz: Twelve. | Lt: Twelve | |
| 03:33 | | 63. T: (Points at “seconds”) listen. This (points at “seconds”. Shows quick movements with her hands). | | |
| | 03:45 | 64. Lp and Ls: (Imitate teacher). | | |
| 03:51 | | 65. T: (Points at “minutes”. Demonstrates a bigger movement). | | |
| | 03:56 | 66. Lp, Lt and Ls: (Imitate teacher’s movements). | | |
| 03:59 | | 67. T: (Points at “hour”.) Hour. | | |
| | 03:59 | 68. Lp, Lt and Ls: Hour, hour. | | |
| 04:02 | | 69. T: Same now. (Removes wall clock from wall). I want you to look now. Look. Where is the one that ticks[26]? (Demonstrates ticking movement) Where is it? | | |
| | 04:15 | 70. Lp, Ls, Lph, Lz: There it is (points at wall clock). | |  |
| | 04:16 | 71. Lt: Twelve. | | |
| | 04:16 | 72. Ls: Eight, six. | Lt: Twelve | |
| | 04:18 | 73. Lt: Six. | | |
| 04:16 | | 74. T: Short and tall, where is it? | Lt: Six | |
| 04:20 | 04:20 | 75. Lp: Its thin and long. | | |
| | 04:26 | 76. Lt, Ls: It’s thin. | | |
| 04:20 | | 77. T: Where is the…? No, the thin… (Puts the wall clock down). It’s thin and short. Do you see it? | | |
| 04:34 | 04:34 | 78. Lp: (Nods). | | |
| 04:35 | | 79. T: Now, I want you to choose where is the one that ticks (demonstrates movement). Where is it? There are three. Where is it? | | |
| 04:46 | 04:42 | 80. Lp: It’s long. There it is (points at wall clock). | | |
| | 04:42 | 81. Lt: It’s long and thin. | | |
| | 04:43 | 82. Ls: There are three. | | |



[25] Learners are fingerspelling the first letters of the words hours, minutes and seconds.
[26] The teacher’s ticking movements does not explicitly show the difference between the hands.

| | | | | |
|---|---|---|---|---|
| 04:47 | 04:45 | 83. T: Where, where? (Demonstrates ticking). For, for, for "S"[27] (refers to "seconds") is where? | | |
| | 04:46 | 84. Lph: It's long. | | |
| | 04:46 | 85. Lz: (Raises her hand) there it is (points at the clock). | | |
| | 04:46 | 86. Lol: It's short, it ticks. | | |
| 04:55 | | 87. T: (Goes to La with the wall clock) where? | | |
| 04:56 | 04:56 | 88. La: It's thin, it ticks, it is short. | | |
| 05:01 | 05:00 | 89. T: Okay. (Goes to the Lan) Where is it? | | |
| 05:03 | 05:02 | 90. Lan: There it is (points at wall clock). | | |
| 05:04 | 05:02 | 91. T: (Returns to La). Let me see. Where is it? | | |
| | 05:03 | 92. La: It's short, thin and it ticks. | | |
| | 05:04 | 93. T: Where is it? Where is the one that ticks for S? (Refers to seconds). | | |
| | 05:10 | 94. La: (Points at clock). | | |
| 05:13 | 05:11 | 95. T: He says it's that one, what do you say ?(Goes to Lan). | | |
| | 05:14 | 96. Lan: (Points at the clock). | | |
| 05:17 | 05:16 | 97. T: That's you. What do you say (To Lol)? | | |
| 05:18 | 05:17 | 98. Lol: (Points at clock). | | |
| 05:20 | 05:18 | 99. T: Okay. (Stands in front of Lod and shows him the clock). | | |
| 05:21 | | 100. Lod: (Points at clock). | | |
| 05:22 | | 101. T: You (Stands in front of Lz with the clock). | | |
| 05:23 | 05:23 | 102. Lz: (Points at clock). | | |
| 05:24 | 05:31 | 103. T: And you (to Lph)? | | |
| 05:26 | | 104. Lph: (Points at second hand). | | |
| 05:27 | | 105. T: She says it's that one (points at second hand). She's right. Now, you. | | |
| 05:32 | 05:30 | 106. Ls: (Points at a hand). | | |
| 05:34 | 05:32 | 107. T: Yes (Goes to Lt and shows her the clock). | | |
| 05:36 | 05:33 | 108. Lt: (Points at the second hand). It's the long thin one. | | |
| 05:39 | | 109. T: (Goes to Lp and shows her the clock). | | |
| 05:39 | 05:38 | 110. Lp: It's that one (points at the clock). | | |
| 05:40 | 05:40 | 111. T: Yes, yes, yes! Listen. (Puts down wall clock). Ok, ok. Look at the thin, long one. Do you see it? It's the same as this (points at the word "seconds". Demonstrates ticking movement). It goes, goes, goes a short way. (Demonstrates ticking movement). | | |
| | 06:30 | 112. (Some learners imitate teacher's ticking movements). | | |
| 06:18 | | 113. T: Yes, ok. Now, (points at the word "minutes") choose two (points at the minute and hour hand on the wall clock) choose where it is (points at the "minutes" written on the board. Demonstrates ticking). Where is it? Which one of the two? Where? Where? (Picks up wall clock and goes to Lp). [*The teacher's ticking movements do not clearly show the difference between the hands*]. | | |
| 06:38 | 06:41 | 114. Lp: (Points at hour hand). | | |

[27] Teacher uses the fingerspelling for "S" to refer to the word seconds. She does not use a sign for "seconds".

| | | | | |
|---|---|---|---|---|
| 06:40 | 06:43 | 115.T: She says it's that one (points at hour hand). Ok. (Goes to Lt and shows her the wall clock). | | |
| 06:45 | 06:44 | 116.Lt: (Points at hour hand). | | |
| 06:46 | | 117.T: Ok. (Goes to Ls and shows him the clock). | | |
| 06:47 | 06:47 | 118.Ls: (Points at hour hand). | | |
| 06:49 | | 119.T: Ok (She shows the clock to Lph). | | |
| 06:50 | 06:48 | 120.Lph: (Points at second hand). | | |
| 06:50 | | 121.T: Where? | | |
| 06:52 | 06:50 | 122.Lph: (Points at minute then hour hands). | | |
| 06:53 | | 123.T: Where is it? Look. Where is it? | | |
| 06:54 | 06:53 | 124.Lph: (Points at minute hand). | | |
| 06:56 | 06:54 | 125.T: (Goes to Lz and shows her the clock). | | |
| 06:57 | 06:56 | 126.Lz: (Points at the wall clock). | | |
| 06:58 | 06:56 | 127.T: (Shows the clock to Lod). Where is it? | | |
| 06:58 | 06:58 | 128.Lod: (Points at the clock). | | |
| 06:59 | 06:58 | 129.T: (Shows the clock to Lol). | | |
| 07:00 | 07:01 | 130.Lol: (Points at the clock). | | |
| | 07:02 | 131.T: (Shows the clock to Lan). Where is it? | | |
| 07:05 | 07:04 | 132.Lan: (Points at the clock). | | |
| 07:07 | 07:04 | 133.T: (Shows the clock to La). Where is it? | | |
| | 07:05 | 134.La: (Points at the clock). | | |
| 07:08 | | 135.T: Ok, good. Yes, I'm happy. (Goes to the board and puts the clock down). Look, this (points at the hour hand on the drawing on the board) is the same as this (points at hour hand on the wall clock. Shows ticking). It is the same. It stands for (points at the word "minutes") M-I-N-U-T-E (fingerspells word). Do you hear? | | |
| 07:33 | | 136.Lp: (Nods). | | |
| | 07:22 | 137.Ls, Lz: (Imitate ticking movement). | | |
| 07:34 | | 138.T: Yes. (Points at the word "hour"). Hour, hour, hour. Where is it? | | |
| | 07:37 | 139.(Some learners repeat): Hour, hour. | | |
| 07:42 | | 140.T: Hour, hour, hour. Where is it? | | |
| | 07:41 | 141.Lt: It's short. | | |
| | 07:42 | 142.Ls: It's thin, hour, hour. | | |
| 07:44 | 07:44 | 143.Lp: Its long. | | |
| | 07:45 | 144.Lt and Ls: It's long. | | |
| 07:48 | | 145.T: It is long, long. Where is it? Where is it (points at clock)? | | |
| | 07:50 | 146.Lt: It's up on top. | | |
| | 07:50 | 147.Lp: Twelve, half. | | |
| | 07:51 | 148.Ls: Twelve, hour, hour, hour. | | |
| 07:53 | | 149.T: It's this one (points at long hand). Hour, hour, hour. Ok. Good. (Puts wall clock on the table). Ok. I'm happy. | | |
| | 08:07 | 150.Lp, Lt: (Chatting to each other). | | |

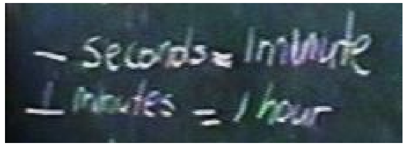
**<u>Criteria with reference to the hands and the terms written on the chalkboard</u>:**

- The thin, long hand is the same as the word “seconds”. She does not explicitly show that the hand represents seconds on the clock. Her previous criteria were that the second hand was thin and short.
- The long, thin hand ticks.
- The second hand moves over a short distance (implicit as she does not make explicit the distance that the second hand travels).
- The word “minutes” is represented by a hand on the clock.
- This hand ticks. The difference between the ticking of the minute and second hands is not made explicit.

**<u>Comments</u>:**

The teacher’s movements do not explicitly show the difference between the hands. The teacher is satisfied that they have pointed to the minute hand; however it seems that the learners are pointing to different hands on the clock.

## Evaluative Event 2.2: The number of seconds in a minute and the number of minutes in an hour

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 08:12 | | 151.T: Now, now (tries to get Lp and Lt’s attention). Listen. Something important you want to know (writes on the board). | |  |
| 09:06 | | 152.T: Listen now (points at” _ seconds” on the board), I want to know how many (ticking movement) makes 1 (ticking movement)? [*The teacher’s question is vague as her demonstration of the ticking does not explicitly show which hand she is referring to*]. Do you hear? When you think, how many? How many? How many (ticking movement) makes 1 (ticking movement)? How many? | | |
| | 09:32 | 153.Lt: Three. | Lt: Three. | |
| | 09:35 | 154.Lph: Eleven. | Lph: Eleven, eleven. | |
| | 09:36 | 155.Ls: Eight. | | |
| | 09:39 | 156.Lt: One… two. | Lt: One, two. | |
| | 09:41 | 157.Lp: Two. | | |
| | 09:42 | 158.Ls: Two… three. | | |
| | 09:43 | 159.Lph: Eleven. | | |
| | 09:43 | 160.Lz: Twelve… ten. | | |
| | 09:49 | 161.Lph: Ten. | Lph: Ten. | |
| | 09:49 | 162.La: Eight. | | |
| | 09:50 | 163.Lan: Ten. | | |
| 09:43 | | 164.T: Eight? Twelve?  Three? Twelve? Ten? | | |
| 09:53 | 09:53 | 165.Lt: Seven, half. | Lt: Seven, half. | |
| 09:54 | | 166.Lp: Eleven, no nine. | | |

| | | | | |
|---|---|---|---|---|
| 09:55 | 09:55 | 167.T: Seven and a half? Twelve? | T: Seven, half? Twelve? | |
| | 09:56 | 168.Ls: Six. | | |
| 09:58 | 09:59 | 169.T: Twelve? | | |
| | 09:57 | 170.Lph: Four. | | |
| | 09:59 | 171.Lz: Seven. | | |
| | 09:59 | 172.Lph: Six. | | |
| 10:02 | | 173.T: Seven. | T: Seven. | |
| | 10:02 | 174.Lz, Lol: Eight. | | |
| | 10:04 | 175.Lph: Six. | | |
| 10:04 | | 176.Lp: Nine. | | |
| 10:06 | | 177.T: Nine. | T: Nine. | |
| | 10:07 | 178.Lt: Twelve. | Lt: Twelve. | |
| | 10:09 | 179.Ls, Lz: Six. | | |
| 10:12 | | 180.T: Ok, listen, (Picks up wall clock). Now. Watch carefully. Look at the small… Look (holding up the wall clock). Look (Draws small lines between 12 and 1on the numbers on the clock). (Shows the learners the wall clock) Look. (Lets Lp hold the wall clock). Look here. The long thin one when it goes… Listen. Where are you looking? (Reprimands Lph). You are telling lies. | | |
| 10:55 | | 181.T: Look now. Do you see the small…? When it arrives here (points at 12 on wall clock), I want you to all start counting. How many? Again, it arrives here (points at 12 on wall clock). Do you hear? I want you to start counting how many, how many times it walk, walk, walks. When it arrives… Oh! It's finished. Leave it then. | | |
| 11:21 | | 182.T: Because we want to start from here (points at 12 on wall clock). How many times it ticks. Yes, ok. Wait, it will arrive now. Look. Wait a bit. | | |
| 11:42 | 11:41 | 183.(Teacher and learners are looking at the wall clock). | | |
| 11:51 | 11:50 | 184.T: Wait a bit. (Teacher and learners continue to look at the wall clock). Do you see? (Points at second hand). | | |
| 12:15 | 12:14 | 185.T: One, two three, four, five, six…. (Educator starts counting and some learners also count. Later, educator just points at second hand as it moves.) | |  |
| 13:11 | 13:10 | 186.T: Sixty. Yes, ok. Now listen, sixty (ticks) make 1 (ticks). Do you hear? (Fills in 60 on the board). | | Teacher writes that there are sixty seconds in one minute. |
| 13:28 | | 187.T: (Points at "60"). Sixty (ticks) make 1 (tick). Do you hear? Makes 1 (tick). Good. (Points at "_minutes = 1 hour"). Sixty. Sixty. (Demonstrates ticking movement). | | |
| 13:48 | | 188.T: Look here. (Goes to wall clock, points at hour hand, demonstrates ticking movement). Do you see? It is the same. The other one is slow and big. The other is slow but small. Yes, do you hear? | |  |
| | 14:11 | 189.(Some learners nod). | | |
| 14:13 | | 190.T: Good. Sixty (ticks) make one hour. Do you hear? Good. (Fills in 60 on the board). | | There are sixty minutes in one hour. |
| 14:26 | | 191.T: Sixty, sixty, sixty (ticks) makes 1 hour. Do you hear? Good. Now, now the other…. Leave that (tells Lp to put wall clock down). Now… leave that (to Lp). | | |

**<u>Criteria with reference to the number of seconds in a minute and the number of minutes in an hour</u>:**

- There are points between the numbers on the clock. The teacher draws the points on the clock between 12 and 1. It is implicit that the points are between all the numbers on the clock.
- The number of seconds in a minute can be found by counting the number of ticks the second hand makes when it moves around the clock. The end point of the minute is not made explicit.
- There are sixty seconds in a minute.
- It is not explicitly stated that a minute consists of one rotation of the second hand around the clock. It is not explained that this is a convention of time measurement.
- Sixty minutes make one hour. The teacher does not explain that this value is a convention

## Evaluative Event 3: Describing the time using conventional terminology and the numbers on the clock

### Evaluative Event 3.1: The terms "past" and "to"

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 14:41 | | 192.T: Now who remembers from last year, this side (Indicates right side of the clock drawn on the board) stands for what? | | |
| | 14:47 | 193.Lt, Ls: Half, half. | Lt: Half, half. | |
| | 14:49 | 194.Lph: Half, half. | Lph: Half, half. | |
| | 14:50 | 195.Lz: Six, half, six, twelve. | | |
| | 14:51 | 196.La, Lo: Six. | Lt: Six. | |
| | 14:52 | 197.Lz, Lan: Quarter. | | |
| 14:53 | | 198.T: Do you remember? Last year this (Indicates right half of the clock) stands for what? | | |
| | 14:56 | 199.Lt: I know….Half six. Long ago I knew it… To, to. | Lt: Half six… To, to. | |
| | 14:56 | 200.Ls: Quarter six, quarter six, quarter to, to one, to one. | | |
| | 14:56 | 201.Lph: Quarter, quarter, quarter, half eight. | Lph: Half… Half eight | |
| | 14:48 | 202.Lz: Half six, half six, to one, to one. | | |
| 15:08 | | 203.T: She's a bit close, a bit, a bit (refers to Lt). To… what is she saying? (Indicates right side of clock) What is it? | | |
| | 15:07 | 204.Ls: Quarter past, quarter past, quarter past. To, to, to. | | |
| | 15:10 | 205.Lph: To… to five, to five, to five. | Lph: To five, to five, to five | |
| | 15:11 | 206.Lz: To, to, to, to. | | |
| 15:17 | 15:16 | 207.(An announcement is made on the intercom while learners are answering). | | |
| | | 208.Lod: Six. | | |
| | 15:17 | 209.Lol: Six. | | |

| | | | | |
|---|---|---|---|---|
| | 15:17 | 210.La: Five. | | |
| | 15:18 | 211.Lan: To…to. | | |
| | 15:18 | 212.Lz: Half six, half six. | | |
| | 15:20 | 213.Lph: Half to five. | | |
| 15:26 | 15:22 | 214.T: Listen, listen do you remember, remember, remember? (Indicates right half of clock). Wait. (Stands in front of the chalkboard facing learners) Left, left, left is past, past, past. Do you remember? | | |
| | 15:38 | 215.(Learners repeat past, past, past). | | |
| 15:42 | | 216.T: Left, left is past, past. What is this side (refers to her right side)? (Indicates left side of clock) What is it? To, to, to, to, ok. | | |
| | 15:48 | 217.(Learners repeat to, to, to). | | |

**Criteria**:

- The clock is divided into a left and right side.
- The right side of the clock is referred to as "past".
- The left side of the clock is referred to as "to".

## Evaluative Event 3.2: Describing the number of minutes past the hour

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 15:53 | | 218.T: Now, do you remember? (Points at 1 on the clock). One stands for who? | | |
| | 15:58 | 219.Lph: Two. | Lph: Two. | |
| 15:59 | | 220.T: Now, this side (Indicates right side of clock) is past, past, past. (Points at 1 on clock) one is the same as who? | | |
| | 16:01 | 221.Lt: Past is on the left. | | |
| | 16:05 | 222.Ls: Past five. | | |
| | 16:06 | 223.Lph: To, to, to. | | |
| 16:08 | | 224.T: One is the same as who? | | |
| | 16:08 | 225.Lt: One, to, no, half. | Lt: One, to, half. | |
| | 16:09 | 226.Lph: Two. | Lph: Two. | |
| | 16:09 | 227.Ls: To… past…past. | | |
| | 16:09 | 228.Lz: Seven, seven, seven. | | |
| | 16:11 | 229.Lt: Half. | Lt: Half. | |
| | 16:12 | 230.Lph: Past, past, past. | | |
| 16:13 | | 231.T: No. | | |
| | 16:14 | 232.Lt: Past seven. | | |
| | 16:16 | 233.Ls: Five. | Ls: Five. | |
| 16:18 | | 234.T: You (points at Ls). | | |
| 16:20 | 16:19 | 235.Lt: Five. | Lt: Five. | |
| | 16:20 | 236.Lph: She's copying you (to Ls). | | |

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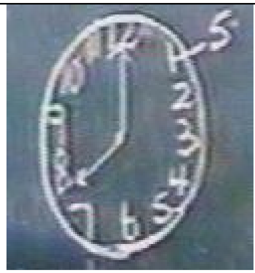
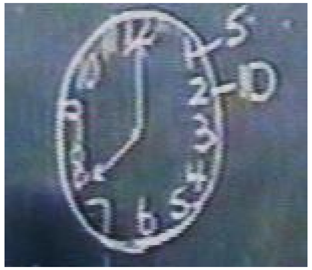
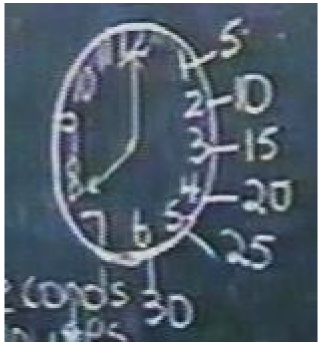
|---|---|---|---|---|
| 16:20 | | 237.T: Five (writes 5 next to 1 on the clock). One, one is same as who? Five. | |  |
| 16:31 | 16:28 | 238.Lph, Ls: Five. | | |
| 16:35 | | 239.T: Yes. (Points at 2 on clock). Two is the same as who? | | |
| | 16:34 | 240.Lt: Four, four, three. | Lt: Four, four, three. | |
| | 16:34 | 241.Ls: Six. | | |
| | 16:35 | 242.Lph: Six. | | |
| | 16:36 | 243.Lod, Lan, Lol: Ten. | | |
| | 16:36 | 244.La: Four. | | |
| | 16:37 | 245.Lan: She's copying. | | |
| 16:39 | | 246.T: Two. Let me see. | | |
| | 16:38 | 247.Lz, Lan, Lol: Ten. | | Teacher maps 5 to 1 on the clock. |
| 16:41 | | 248.Lt: Ten, ten, ten. | Lt: Ten, ten, ten. | |
| 16:42 | 16:41 | 249.T: You! (Points at Lan). | | |
| 16:46 | | 250.T: (Writes 10 next to 2 on the clock). Three is the same as who? | |  |
| | 16:49 | 251.Lan: Fifteen, fifteen. | | |
| | 16:49 | 252.Lz: Twenty five, twenty five. | | |
| 16:49 | | 253.Lt: Fifteen. | Lt: Fifteen, fifteen. | |
| | 16:52 | 254.La, Lan, Lod, Lz, Lph: Fifteen, fifteen. | | |
| 16:53 | | 255.T: Fifteen, fifteen? Yes, okay. (Writes 15 next to 3 on the clock).Four? | | |
| | 16:58 | 256.Lp: Twenty, twenty. | | |
| 16:59 | 16:59 | 257.Lt, Ls: Twenty, twenty, twenty. | | |
| | 17:00 | 258. | Lt: Twenty, twenty, twenty. | |
| 17:00 | | 259.T: Twenty, twenty. Yes. (Writes 20 next to 4 on the clock). | | Teacher maps 10 to 2 on the clock. |
| | 17:05 | 260.Lph: Twenty, twenty. | Lph: Twenty, twenty. | |
| | 17:07 | 261.Lod: Forty, forty. | | |
| 17:08 | | 262.Lt: Twenty five | Lph: Twenty, twenty. | |
| 17:09 | | 263.T: (Points at 5) This? | | |
| | 17:08 | 264.Lz, Lod, Lol, Lan: Twenty five. | Lt: Twenty five. | |
| 17:11 | | 265.T: (Writes on 25 next to 5 on the clock). This (points at 6)? | |  |
| | 17:11 | | Lt: Twenty five, twenty five, twenty five. | |
| | 17:12 | 266.Lt, Lph, Ls: Thirty, thirty, thirty. | Lph: Thirty. | |
| 17:13 | | 267.Lp: Thirty, thirty, thirty. | Lt: thirty, thirty, thirty. | |
| 17:15 | | 268.T: Thirty, thirty (writes 30 next to 6 on the clock). (Points at 7). | | |
| 17:19 | 17:19 | 269.Lp: Thirty five. | | |
| | 17:20 | 270.Lt: Thirty five. | Lt: Thirty-five, thirty-five, thirty-five. | |
| | 17:20 | 271.Ls: To, to, to. Thirty five, thirty five, thirty five. | | |
| 17:23 | | 272.T: Thirty-five. You (points at Ls). Wait, wait, wait (to Lt). Listen now. Be quiet, if you know, don't tell. Hide it, hide it. Do you hear? If a person knows, hide it. Now, I'm going to ask each one of you a question to see if you know. Ok? Don't tell. (Points at 30). Who knows this now? You help me (points at Lod). This (points at seven) is the same as who? | Lt: Odwa. | Teacher continues to map numbers from 3 to 6 on the clock. |
| | 17:55 | 273.Lo: Thirty five… thirty five, thirty five, thirty five. | | |

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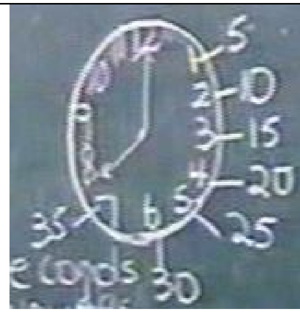
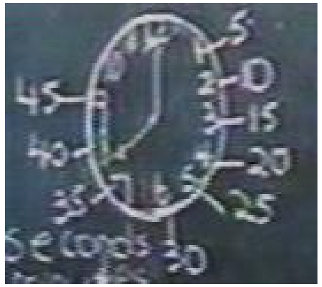
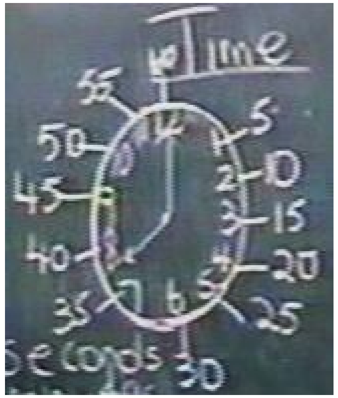
|---|---|---|---|---|
| 18:00 | | 274.T: Three… Ok. (Writes 35 next to 7 on the clock). (Points at 8). You (Points at Lol). Eight is the same as who? | |   |
| | 18:15 | 275.Lol: Twenty one. | | |
| | 18:16 | 276.Lan: No. | | |
| | 18:18 | 277.Lol: I don’t know. | | |
| 18:22 | | 278.T: Don’t look at the camera. Who is it? | | |
| | 18:25 | 279.Lol: (Points at the clock on board). Forty, forty. | | |
| | 18:28 | 280.Lan: No, it’s fifty. | | |
| 18:30 | | 281.T: Yes, yes, yes. (Writes 40 next to 8 on the clock). | | |
| | 18:36 | 282.Lph: Fifty. | | |
| 18:37 | | 283.T: Nine is the same as who? Who will I choose? (Walks around the class). You! (Points at Lph). Nine is the same as who? | | |
| 18:48 | 18:47 | 284.Lph: Fifty[28] | Lph: Ninety. |   |
| 18:49 | | 285.T: Ninety? Is that true? She says it’s the same as ninety. Is that true, true, true? | T: Nyani? *(Really?)* | |
| 18:55 | 18:55 | 286.Ls, Lz: She is wrong. | | |
| 18:59 | | 287.T: No. Who will help Nomhle? Who? You (points at La) help me. | | |
| | 19:06 | 288.La: Twenty five, fifty five, fifty five. | | |
| 19:06 | | 289.T: Help me. | | |
| | 19:08 | 290. | Lt: Forty five. | |
| 19:12 | | 291.T: No. Who will I choose now? You are finished (to Lt) You (Ls), help me. Nine is the same as who? | | |
| | 19:22 | 292.Ls: Twenty four, twenty four. | | |
| | 19:23 | 293.Lt: Twenty four is wrong. | Lt: Fifty five. | |
| | 19:25 | 294.Lp: He is wrong. It’s forty two. | | |
| 19:27 | | 295.T: No. (She looks at the learners deciding who to ask). | | |
| 19:35 | 19:34 | 296.T: You (points at Lan) help me. | |   |
| | 19:36 | 297.Lan: Fifty four, fifty four, fifty four. | | |
| 19:42 | | 298.T: What comes first? Say it again. (Points at Lan) Again. | | |
| | 19:48 | 299.Lan: Fifty four, fifty four. | | |
| | 19:51 | 300.Ls: She is wrong. | | |
| 19:49 | 19:53 | 301.T: No. You (Lz). | | |
| | 19:53 | 302.Lz: She is wrong. It’s forty five. | | |
| 19:55 | | 303.T: That’s it. (To Lan) You said fifty four. You started with five. It starts with who? Four then five. Do you see? Yes. Change yours. (Writes 45 next to 9 on the clock). (Points at 10). Ten. | | |
| | 20:18 | 304.Ls: To, eleven o’clock. | | |
| | | 305.Lz: (Response not recorded). | | |
| 20:20 | | 306.T: Don’t tell. You (Lt). | | Teacher continues to map a new domain of numbers onto the numbers on the clock. |
| 20:26 | 20:24 | 307.Lt: Forty. No… I don’t know. | Lt: Forty. | |
| 20:32 | | 308.T: How many, how many? (Points towards the board). Forty-five, forty-five. | | |

[28] Learners signs “fifty” but calls out “ninety”.

| | | | | |
|---|---|---|---|---|
| | 20:37 | 309.Lt: Forty five. | | |
| 20:39 | | 310.T: Who comes after that? | | |
| | 20:40 | 311.Lt: After that? | | |
| 20:45 | | 312.T: Don't tell. | | |
| 20:47 | 20:47 | 313.Lt: Forty seven, forty seven. I don't know. | Lt: Forty seven, forty seven. | |
| 20:49 | | 314.T: (Shakes her head). You (Lp) help her. | | |
| 20:56 | | 315.Lp: Fifty. | | |
| | 20:57 | 316.Lt: Fifty. | | |
| | 20:57 | 317.Ls: It's fifty. You didn't know. Fifty, fifty | | |
| 20:57 | | 318.T: Fifty, fifty. (Writes on 50 on the clock). (Points at 11) you (Lod) (points at 11). | T: Odwa. | |
| | 21:08 | 319.Lo: Me? Fifty five, fifty five, fifty five. | | |
| 21:14 | | 320.T: Yes. (Writes 55 on the clock). (Points at 12). | | |
| | 21:19 | 321.Lz: (Raises her hand). Sixty. | Lph: Sixty. | |
| 21:23 | | 322.T: Yes. (Writes 60 on the clock). | | |
| 21:27 | <br><br><br>22:09<br>22:12<br>22:14<br>22:17<br>22:21<br>22:23 | 323.T: It's the same. Look, we said sixty, sixty minutes (ticks) make 1 hour. Do you remember? Remember? (Points at the minute hand, then to the hour hand. Demonstrates movement of minute hand on the clock from 12 to 1, moving on to 2, then 3). Do you see? (Demonstrates that the hand moves from 3 to 4). Do you see? (Demonstrates that the hand moves from 12, past 1, 2, 3, 4, till 5). Do you see? (Indicates that the hand moves from 12 to 6). Do you see? (Shows that it moves from 12 to 7. The hand moves from 12 to 8. The hand moves from 12 to 9. The hand moves from 12 to 10. The hand moves from 12 to 11. The hand moves from 12). An hour. The time changes. Now when you see it arrives at 12, the time changes. Hey? The hour changes. Do you hear? | T: Sixty, sixty minutes make 1 hour. Uyakhumbula? (*Do you remember?*)<br>Lt: Seven.<br>Lt: Eight.<br>Lt: Nine.<br>Lt: Ten.<br>Lt: Eleven.<br>Lt: Sixty. |  The new domain of numbers is written next to the first domain. |

**<u>Criteria</u>:**

- The domain of numbers 1-12 on the clock are mapped to a co-domain of numbers.
- It is implicit that the new domain of numbers is the number of minutes past the hour. The teacher does not explain what these numbers mean and that they are a convention of time measurement.
- The numbers in the co-domain are multiples of 5 ((n) $\rightarrow$ 5n) where n represents the numbers 1-12 on the clock and 5n represents the corresponding minute component of time.
- There are sixty minutes in an hour. It is implicit that the minute hand moves around the clock and when it gets back to 12, the hour changes.

## Evaluative Event 3.3: Describing the time using the number of minutes past the hour

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 22:37 | | 324.T: Now (points at 1 on the clock), who remembers this side (indicates right side of clock). Who? Past, past, past. | | |
| | 22:42 | 325.Lt, Ls, Lph, Lz: Past, past, past. | Lt: Past, past, past. | |
| 22:44 | | 326.T: This side (indicates left side). To, to, to, to. | | |
| | 22:44 | 327.Lt: Seven, to, to, to. | Lt: To, to, to, to. | |
| | 22:45 | 328.Lod, Lz, Lph, Ls, Lan: To, to, to. | | |
| 22:48 | | 329.T: Who stands here? | | |
| | 22:50 | 330.Lt, Ls: Five. | Lt: Five. | |
| | 22:50 | 331.Lph: Seven….Five. | | |
| | 22:53 | 332.Lod, Lol: Five. | | |
| 22:51 | | 333.T: Five what? Five what? | | |
| | 22:54 | 334.Lod: Five. | | |
| | 22:54 | 335.Lph: Ten. | Lph: Ten. | |
| | 22:54 | 336.Lol: Five past, five past. | | |
| 22:56 | | 337.T: (Points at Lo). Yes. Five past, five past. | | |
| | 22:56 | 338. | Lt: Five past, five past. | |
| | 22:59 | 339.Lz: Past five. | | |
| 23:00 | | 340.T: (Points at 10). | | |
| | 23:00 | 341.Lod, Ls: Ten past. | | |
| | 23:00 | 342.Lph: Ten to, ten… | | |
| | 23:01 | 343.Lt: Ten to, no. | Lt: Ten to. | |
| 23:03 | | 344.T: No, this (points at 10). | T: Hayi *(no).* | |
| | 23:03 | 345.Lt: Ten past. | Lt: Ten past. | |
| | 23:04 | 346.Ls: Ten past, ten past. | | |
| | 23:04 | 347.Lph: Ten, seven. | | |
| | 23:05 | 348.Lz: Two past ten, two past ten. [*Learner uses number in domain and co-domain*]. | | |
| | 23:06 | 349.Lod: Ten to | | |
| 23:08 | | 350.T: Who? Stands for what? Ten what? (Points at ten). | T: Ten, ntoni, ten ntoni? *(Ten what, ten what?)* | |
| | 23:09 | 351.Lz: (Raises her hand) Two past ten. | | |
| | 23:10 | 352.Lan, Lol: Ten past. | | |
| | 23:12 | 353.Lph: Ten past. | | |
| 23:12 | | 354.T: (Points at Lp). | | |
| 23:13 | | 355.Lp: (Response not recorded) | Lt: Ten past. | |
| 23:14 | | 356.T (To Lt): Say that again. | Lt: Ten past. | |
| 23:15 | | 357.Lp: (Response not recorded). | | |
| 23:16 | | 358.T: Yes, ten past. | T: Ten past. | |
| | 23:15 | 359.Lt: I said ten past! | Lt: Ten past. | |
| 23:22 | | 360.T: No, you said ten to. Yes, that's what you said. (Points at 15 on the clock). | T: Tyhini (*Goodness!*) | |

| | | | | |
|---|---|---|---|---|
| | | Who is this? | | |
| | 23:28 | 361.Lt, Ls, Lph, Lz, Lod, Lan: Fifteen past, fifteen past. | Lt: Fifteen past | |
| 23:32 | | 362.T: Yes, fifteen past. Ok, ok, ok. But remember last year we said fifteen is the same as who? | | |
| | 23:44 | 363.Lt: Seven. | | |
| 23:44 | | 364.T: Ok, ok. Wait. Fifteen, fifteen past is right. We'll say it again in a new way, do you hear? [*Teacher realises that fifteen past is not the conventional way to describe the time and she needs to construct new criteria to describe this number*]. Ok. (Points at 20 on the clock). Who is this? | | |
| | 23:54 | 365.Lt, Ls, Lp, Lph: Twenty past. | Lt: Twenty past. | |
| 23:57 | | 366.T: Twenty past. (Points at "25"). | | |
| | 23:58 | 367.Lt, Lp, Ls, Lph, Lz: Twenty five past. | Lt: Twenty five past. | |
| 24:00 | | 368.T: (Points at "30"). | | |
| | 24:00 | 369.Lt: Thirty half, thirty half. | Lt: Thirty half, thirty half. | |
| | 24:01 | 370.Lp: Three past. | | |
| | 24:01 | 371.Ls: Thirty, quarter, quarter, quarter. Thirty | | |
| | 24:01 | 372.Lph: Thirty past. | | |
| | 24:01 | Lz: Thirty, half, thirty, half. [*Some learners seem to be familiar with "half" representing thirty*]. | | |
| 24:04 | | 373.T: Thirty. Half. Thirty, half. Thirty. | | |
| | 24:07 | 374.Lph: Five. | Lph: Five. | |
| | 24:07 | 375.Lo: Half. | | |
| | 24:08 | 376.La: Half thirty, half thirty. | | |
| | 24:08 | 377.Lol, Lan: Thirty past. | | |
| 24:11 | | T: But remember we said here (points at 15) fifteen past, fifteen past. Why (points at 30) is thirty half? Why? [*The question is vague. The teacher seems to be questioning why they know that that thirty is half but are unable to say what the conventional way to describe fifteen is*]. | T: But remember ndithe apha *(I said here)* 15 past né, fifteen past, thirty half, why? | |
| | 24:23 | 378.Lph: Half five, half five. | | |
| | 24:23 | 379.Lz: Quarter, quarter. | | |
| | 24:23 | 380.Ls: Thirty quarter, thirty quarter. half, half, half. | | |
| | 24:23 | 381.Lt: Quarter, quarter no… to. | | |
| | 24:27 | 382.Lol: Thirty past, thirty past. | Lt: Half… to? | |
| | 24:27 | 383.Lan: Half, thirty, half. | | |
| 24:30 | | 384.T: He said thirty past. Yes. Good! | | |
| | 24:31 | 385. | Lt: Thirty past | |
| | 24:34 | 386.Ls: Thirty past. | | |
| 24:33 | | 387.T: Yes! By saying fifteen past, similarly, we say thirty past. Ok. Now (points at 35 on the clock). | T: Ewe *(yes)*! Same ndithe mna *(I said)* fifteen past ne same né thirty past, ok. | |
| | 24:44 | 388.Lt: Seven, half, five. | | |
| | 24:44 | 389.Ls: To, to, to. Thirty five, thirty five, quarter, quarter, to, to. | Lt: Seven, half. | |
| | 24:44 | 390.Lod: half, half, half, thirty five, half, thirty five. | | |
| | 24:45 | 391.Lph: Thirty five past, thirty five past. | | |

| | | | | |
|---|---|---|---|---|
| | 24:46 | 392.Lol: Thirty five half, thirty five half. | | |
| | 24:47 | 393.Lz: Thirty five to, thirty five to. | | |
| | 24:47 | 394.La: Half…two. | | |
| | 24:47 | 395. | Lt: Thirty five. | |
| | 24:48 | 396.Lan: Half, five. | | |
| | 24:49 | 397.Ls: To, to, to, to. | Lt: To, to, to, to. | |
| | 24:51 | 398.La: Thirty five to. | | |
| | 24:53 | 399.Lt: Thirty five past, thirty five past. | Lt: Thirty five past, thirty five past. | |
| 24:53 | | T: (Looks at Lp) Thirty five past. [*The teacher's criteria now fail as the left side of the clock was previously described as "to" but the minutes written on the board are the minutes past the hour*]. Okay. (Points at 40 on the clock). | T: Thirty five past, okay. | |
| | 24:59 | 400.Lt: Forty to. | Lt: Forty to. | |
| | 24:59 | 401.Lz: It's to, to, to (to Lt). | | |
| | 25:00 | 402.Ls, Lph: Forty past. | | |
| 25:02 | | 403.T: Forty to? (Looks questioningly at the learners). | T: Forty to? | |
| | 25:02 | 404.Lz: Forty to, forty to, forty to. | | |
| | 25:03 | 405.Lod: Forty, half. | | |
| | 25:04 | 406.Lol: Forty past. | | |
| | 25:04 | 407.Lan: Forty. [*Learners seem unsure of whether to use "past" or "to"*]. | | |
| | 25:04 | 408.La: Past forty. [*Learners seem confused due to ambiguity of the criteria*]. | Lt: Forty past. | |
| 25:06 | | T: Forty past (points at 45). [*The teacher continues to describe the minutes as "past" but the reason for doing so is not made clear as the previous criteria described the left side as "to" when telling the time*]. | T: Forty past, okay. | |
| | 25:07 | 409.Lol: Forty five past. | | |
| | 25:08 | 410.Ls, Lph, La: Forty five past. | | |
| 25:10 | | 411.T: (Points at 50 on the clock). | | |
| | 25:10 | 412.Lt, Ls, Lph, Lz: Fifty past. | Lt: Fifty past. | |
| 25:12 | | 413.T: (Points at 55 on the clock). | | |
| | 25:12 | 414.Ls, Lt, Lph, Lz: Fifty five past. | Lt: Fifty five past. | |
| 25:15 | | 415.T: (Points at 60 on the clock). | | |
| | 25:15 | 416.Lt: Twelve o'clock, half. | Lt: Twelve, half. | |
| | 25:15 | 417.Ls: Twelve o'clock, twelve o'clock, half. | | |
| | 25:16 | 418.Lp: Half… I don't know. | | |
| | 25:16 | 419.Lph: Sixty to. | | |
| 25:18 | | 420.T: Ok, I hear you. Good. [*The teacher accepts the learners' answers however the time should be eight o'clock according to the hands drawn*]. | | |

**Criteria:**

- It is implicit that the numbers in the co-domain are the number of minutes past the hour.
- The teacher's previous criteria fail as the left side of the clock was previously described as "to".
- The teacher does not use the hands of the clock to show that it is the number of minutes past and to the hour. It is implicit that there are minute and hour hands.

**Comments**:
The learners were unsure whether to describe the minutes as “past” or “to” the hour. The teacher did not clarify why she did not describe the minutes on the left side of the clock as the number of minutes “to” the hour.

## Evaluative Event 3.4: Terminology to describe the time when the minute hand is at three, six, nine and twelve on the clock

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 25:21 | | 421.T: Now. Listen. I want to tell you something new about fifteen. Fifteen. (Writes on board). | |  |
| 25:46 | | 422.T: Listen… | | |
| | 25:57 | 423.Ls: Quarter, quarter. | | |
| 25:49 | | 424.T: Yes, yes. This (points at 15) is fifteen, fifteen. But when you tell the time, you say quarter, quarter. This (points at 15) is who? Quarter, quarter, quarter. | | |
| | 26:00 | 425.Lt, Lph, Lz, Ls: Quarter, quarter, quarter. | | |
| 26:05 | | 426.T: This (points at 30) is half, half, half. | | |
| | 26:05 | 427.Lph: Half. | Lt: Half. | |
| | 26:07 | 428.Ls, Lz: Half. | | |
| 26:10 | | 429.T: (Points at 45). It’s the same, do you hear, as quarter, quarter, quarter, quarter. | | Teacher refers learners to these numbers from the co-domain. |
| | 26:10 | 430.Lt: Past. | Lt: Past. | |
| | 26:10 | 431.Ls, Lph: It’s the same. | | |
| | 26:13 | 432.Lz, Lph, Lt, Ls: Quarter, quarter, quarter. | | |
| 26:17 | | 433.T: (Points at 60). It’s o’ clock, o’ clock, o’ clock. Okay. Good. | | |
| | 26:18 | 434.Lp, Lt, Ls, Lph, Lz: O’clock, o’clock. | | |
| 26:24 | | 435.T: Now, now. Yes. Now, I want to know… who is this? (Points at 5 on the clock). | | |
| | 26:28 | 436.Lp, Lt, Ls, Lph, Lz: Five past. | | |
| 26:29 | | 437.T: Five past. (Points at 10) It is ten past. | | |
| | 26:30 | 438.Lp, Lt, Ls, Lph, Lz: Ten past. | Lt: Ten past. | |
| 26:32 | | 439.T: (Points at 15 on the clock). | | |
| | 26:32 | 440.Lt: Fifteen, quarter. | | |
| | 26:32 | 441.Lp: Fifteen. | | |
| | 26:32 | 442.Ls: Fifteen past. | | |
| | 26:32 | 443.Lz, Fifteen, quarter, fifteen, quarter. | Lt: Fifteen, half[29]. | |
| | 26:33 | 444.Lph: Quarter. | Lph: Half[30] . | |
| 26:34 | | 445.T: No, no, no, not that. I don’t want fifteen. Remember, who is this (points at | | |

[29] The learner signs “quarter” but says “half”.
[30] This learner also shows a discrepancy between her signing and speech.

| | | | | |
|---|---|---|---|---|
| | | 15)? | | |
| | 26:36 | 446.Lz: Fifteen, quarter, fifteen, quarter, quarter. | | |
| | 26:39 | 447.Lph: Quarter. | | |
| | 26:40 | 448.Lan: Quarter, quarter. | | |
| 26:40 | | 449.T: Yes. (Points at 15 on the clock). | | |
| | 26:42 | 450.La, Lol: Quarter, quarter. | | |
| | 26:43 | 451.Lod: Past. | | |
| | 26:43 | 452.Lz: Fifteen, fifteen, fifteen. | | |
| 26:43 | 26:43 | 453.T: Quarter what? | | |
| | 26:44 | 454.Lph: Fifteen. | Lt: Fifteen, half. | |
| | 26:44 | 455.Ls: Quarter, fifteen. | | |
| | 26:44 | 456.Lz: Fifteen, fifteen. | | |
| | 26:44 | 457.Lod: Fifteen. | Lt: Half. | |
| | 26:45 | 458.Lt: Quarter. | | |
| 26:45 | | 459.T: Who is it? | | |
| | 26:47 | 460.Lph: Quarter, fifteen. | | |
| | 26:47 | 461.Lt: Quarter. | Lt: Fifteen. | |
| | 26:47 | 462.Ls: Fifteen, quarter. | | |
| | 26:48 | 463.Lz: Fifteen. | | |
| 26:48 | | 464.T: Who is it (points at 15 on clock)? | T: Fifteen, fifteen ntoni? *(Fifteen, fifteen what?)* | |
| | 26:50 | 465.Ls: Half, half. | | |
| | 26:51 | 466.Lp: Fifteen, quarter. | | |
| 26:50 | | 467.T: Quarter, fifteen what? | | |
| | 26:54 | 468.Lt: Quarter, quarter, quarter. | | |
| 26:53 | | 469.T: Quarter, quarter? | | |
| | 26:56 | 470.Lan: Fifteen? [*The learners' responses indicate that they are not sure about the criteria for describing "15" on the clock*]. | | |
| 26:57 | | 471.T: Remember this side (shows right side of clock).stands for what? All of it is for past, past. | | |
| | 26:59 | 472.Lol, Lz: Past. | | |
| | 27:00 | 473.Lan: Past, past. | | |
| 27:01 | | 474.T: Who is this (points at 15 on the clock)? | | |
| | 27:01 | 475.Lan: Quarter past. | | |
| | 27:01 | 476.Lz: Past, past, past. | | |
| | 27:02 | 477.Lph: Quarter, fifteen past. | | |
| | 27:04 | 478.Ls: Fifteen past, past. | | |
| | 27:05 | 479.Lt: Fifteen. | Lt: Fifteen, half, fifteen. | |
| | 27:05 | 480.Lod: Quarter. | | |
| | 27:07 | 481.La: Five past, five past. | | |
| | 27:08 | 482.Lph: Fifteen past. | | |
| | 27:09 | 483.Lan: Quarter, five. | Lt: Half, fifteen. | |
| 27:10 | | 484.T: (Shakes her head at learners' responses). | | |
| | 27:12 | 485.Lz: Fifteen, half, fifteen, half, fifteen, half. | | |

| | | | | |
|---|---|---|---|---|
| | 27:14 | 486.Lan: Half, fifteen. | | |
| | 27:15 | 487.Lol, Lod: Fifteen past. | | |
| | 27:15 | 488.Lph: Half, fifteen. | | |
| | 27:17 | 489.Lt: Quarter, fifteen. | Lt: Half, fifteen past | |
| | 27:19 | 490.Ls: Fifteen past. | | |
| | 27:20 | 491.Lph: Quarter (tries to get teacher's attention) past. | | |
| 27:21 | | 492.T: No. Why are you saying fifteen, fifteen again? Don't tell me fifteen. | T: Hayi *(no)*, why, why again fifteen, fifteen. Tell fifteen, no. | |
| | 27:26 | 493. | Lt: No. | |
| 27:28 | | 494.T: Remember, we said fifteen, fifteen is the same as what? | T: Ewe *(yes)*. Remember, ndithe fifteen, fifteen fana nabani? *(I said fifteen is the same as who?)* | |
| | 27:32 | 495.Lt: Quarter. | | |
| | 27:33 | 496.Ls: Half, half. | | |
| 27:32 | | 497.T: Quarter, quarter. Now, throw away the fifteen, throw away the fifteen. Throw it. Only… [*Teacher restates previous criteria*]. | T: Now… | |
| | 27:38 | 498.Lz: To, to, to. | | |
| | 27:39 | 499.Lph: (Tries to get teacher's attention) quarter, five. | Lph: Five. | |
| | 27:42 | 500.Lod, La: Five. | | |
| 27:42 | | 501.T: (Shakes her head) | | |
| | 27:43 | 502.Lph: Quarter, five. | Lph: Five. | |
| 27:43 | | 503.Lp: (Tries to get teacher's attention. Signing not recorded). | | |
| 27:46 | | 504.T: Where? | | |
| | 27:46 | 505.Lp: Quarter, fifteen. | | |
| 27:48 | | 506.T: No. | | |
| | 27:48 | 507.Lt: You must throw it away. | | |
| 27:50 | 27:49 | 508.Lp: (Tries to get teacher's attention) Quarter. | | |
| 27:52 | | 509.T: Throw it away, throw it away. Fifteen, fifteen, throw it away. | T: Lahla, lahla fifteen, fifteen *(throw away, throw away)*. | |
| | 27:57 | 510.La: Four. | | |
| | 27:57 | 511.Lz: To, to, to. | | |
| 27:57 | | 512.T: Throw…fifteen, fifteen throw it. Leave only quarter. | | |
| | 28:00 | 513.Lp: Thirty. | | |
| 28:02 | | 514.T: (Shakes her head). | | |
| | 28:04 | 515.Lt: Quarter, o'clock. | | |
| | 28:04 | 516.Lph: Quarter, half, fifteen. | | |
| | 28:05 | 517.Ls: Sixty seven, half, to, seven. | | |
| | 28:14 | 518.Lph: Quarter, fifteen. | | |
| 28:14 | | 519.T: (Shakes her head at the learners' responses). | | |
| 28:15 | | 520.T: We said fifteen, fifteen (points at fifteen on clock). Leave it. Now Nomhle told you something new. Fifteen is the same as who? Quarter, quarter. | T: Ndithe le, le fifteen, fifteen lahla. Now, Nomhle unixelele new. Ba-fifteen, fifteen fana nabani? *(I said this fifteen, fifteen throw away. Nomhle told you new. Fifteen is the same as who?)* | |

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|---|---|---|---|---|
| | 28:25 | 521.Lt, Lp, Lph, Ls: Quarter. | | |
| 28:27 | | 522.T: Now who is this (points at 15 on the clock)? | T: Now, ngubani ke ngoku? *(Now, who is it now?)* | |
| | 28:28 | 523.Lt: Three. | Lt: Three. | |
| | 28:28 | 524.Lph: Quarter, o'clock, quarter, quarter. | | |
| 28:31 | | 525.T: No. You a bit close (to Lph). | | |
| | 28:32 | 526.Lph: I'm a bit close. | | |
| | 28:34 | 527.La: Five. | | |
| | 28:34 | 528.Lz: Three. | | |
| | 28:35 | 529.Lo: Forty five past, forty five past. | | |
| 28:39 | | 530.T: (Looks at La). You try. | | |
| | 28:40 | 531.La: Half five. | | |
| | 28:43 | 532.Lph: Quarter, forty five. | | |
| 28:43 | | 533.T: Leave five. What is it? | | |
| | 28:44 | 534.Lt: Nought. | Lt: Half four, half 0. | |
| | 28:46 | 535.Lol: Half five. | | |
| 28:46 | | 536.T: No. | | |
| | 28:48 | 537.Ls: Half five. | | |
| | 28:50 | 538.Lp: Three. | | |
| 28:48 | | 539.T: Okay, let's start again. Let's start again. Who is this (points at 5 on the clock)? | T: Again, start… le ngubani? *(Who is this?)* | |
| | 28:54 | 540.Lp: Quarter past… five. | | |
| 28:54 | | 541.T: We are starting again. | T: Again, start. | |
| | 28:55 | 542.Ls, Lt, Lp, Lph: Five past. | | |
| 28:58 | | 543.T: Yes, good. Five past. And this (points at 10 on the clock)? | T: Good, good. Le (this) five past. Lena (And this one)? | |
| | 29:02 | 544.Lp, Lt, Ls, Lph, Lz: Ten past. | | |
| 29:05 | | 545.T: That's it. (Points at 15). | T: Good. Lena ngubani? *(And this? Who is this?)* | |
| | 29:05 | 546.Lp, Ls: Fifteen past. | | |
| | 29:06 | 547.Lph: Fifteen, quarter, o'clock. | | |
| | 29:08 | 548.Lt: Past fifteen. | Lt: Past fifteen. | |
| | 29:11 | 549.La: Past… | | |
| 29:11 | | 550.T: (Shakes her head at the learners' responses). | | |
| | 29:12 | 551.Lz: To, to, to | | |
| 29:16 | 29:17 | 552.T: (Points at Lp). | T: Ja, ja. | |
| | | 553.Lp: (Response not recorded). | | |
| 29:20 | 29:19 | 554.T: Good, good. | T: Good, good. | |
| | | 555.Ls: Quarter past. | | |
| 29:21 | 29:20 | 556.T: Who's copying? Who? | T: Kopa bani, kopa bani? (Who is copying? Who is copying?) | |
| 29:23 | | 557.Lp: You lying, lying, lying. | | |
| | 29:23 | 558.Lan: He said that. | | |
| | 29:24 | 559.Lol: I said so. | | |
| 29:25 | 29:24 | 560.T: Oh, ok. Sorry. I see. Ok. Yes, yes (points at 15 on the clock). Who is this? | T: Ja, ja. | |

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|---|---|---|---|---|
| | 29:31 | 561.Lt, Lp, Ls: Quarter past, quarter past. | | |
| 29:33 | | 562.T: Quarter past, quarter past. Who is this (points at 20 on clock)? | T: Quarter past. | |
| | 29:38 | 563.Lp: Twenty past. | | |
| | 29:39 | 564.Lt: Twenty past. | Lt: Twenty past. | |
| | 29:40 | 565.Ls: Twenty half past. | | |
| 29:40 | | 566.T: Twenty past. (Points at 25 on the clock). | | |
| | 29:42 | 567.Lp, Lt, Ls, Lph: Twenty five past. | | |
| 29:43 | | 568.T: Twenty five past. (Points at 30) half. | | |
| | 29:45 | 569.Lt, Ls: Half, half, half. | Lt: Half, half. | |
| | 29:45 | 570.Lp: Quarter, quarter. | | |
| 29:46 | | 571.T: It is the same as thirty, thirty (points at "30" on the board). Remember half past, half past. | | |
| | 29:49 | 572.Lt, Lp, Ls, Lph, Lz: Half past. | Lt: Half past, half, half. | |

**Criteria for telling the time at 15, 30, 45 and 60 minutes past the hour:**

- Fifteen is the same as quarter.
- Thirty is the same as half.
- Forty five is the same as quarter.
- Sixty is the same as o'clock.

The teacher's mapping is as follows:
3 → 15 → quarter
6 → 30 → half
9 → 45 → quarter
12 → 60 → o'clock

**Comments:**
The teacher does not explain that these are conventions for describing the time. Sixty becomes o'clock as she probably doesn't have an explanation for why it should not be included with 15, 30 and 45. The learners' responses indicate that they are confused due to multiple mappings which created ambiguity at the level of the criteria.



## Evaluative Event 3.5: Describing numbers symmetrically opposite each other on the clock

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 29:53 | | 573.Good. Now, listen, remember, listen. (Points at 1 on clock) One (Writes on the board). | T: Now…Le 1 *(this 1)*.<br>T: (Talks while writing) One is equal to eleven nè? Ten, two is equal to | |

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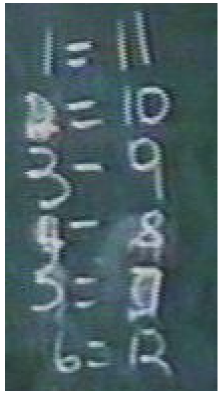
| | | | ten, three is equal to nine, seven is equal to five, six is equal to twelve. |  |
| 30:32 | | 574.T: Remember, listen. Who is this? (Points at 1). Who is one? [*Teacher's question is ambiguous*]. | T: Okay, mamela ke *(listen now)*. One ngubani? *(Who is one?)* | |
| | 30:37 | 575.Lt, Lph: One. | Lt: One. | |
| | 30:39 | 576.Lp: Five. [*Previous criteria stated that one was the same as five*]. | | |
| 30:39 | | 577.T: Five past. | T: Five past. | |
| | 30:39 | 578.Lt, Ls, Lph: Five past. | Lt: Five past. | |
| 30:41 | | 579.T: (points at 2). | T: Two? | |
| | 30:43 | 580.Lp, Lt, Ls, Lph: Ten past. | Lt: Ten past. | |
| 30:42 | | 581.T: Ten past. (Points at 3). | T: Ten past. Three? Quarter past. | |
| | 30:44 | 582.Lp: Fifteen. | | |
| | 30:44 | 583.Lt: Half past. | Lt: Half past. | |
| | 30:45 | 584.Ls, Lph: Quarter past. | | |
| 30:46 | | 585.T: Quarter past. (Points at 8). | | The teacher has mapped another domain of numbers which are symmetrically opposite each other on the clock. |
| | 30:47 | 586.Lt: Eight. | | |
| | 30:48 | 587.Ls: Half past, half past. | | |
| | 30:48 | 588.Lt: Twenty. | Lt: Twenty | |
| | 30:48 | 589.Lph: Four. | Lph: Four | . |
| 30:48 | | 590.T: (Points at 4) Four… (Looks at writing on the board and changes 4 and 8 around. Then changes 7 and 5 around) | T: …seven nè, okay. |  |
| 31:08 | | 591.T: (Points at one). What is one? | T: One ngubani? *(Who is 1?)* | |
| | 31:08 | 592.Lph: Five past. | | |
| | 31:08 | 593.Lp: Half, five past. | | |
| | 31:09 | 594.Lt: One is five past. | Lt: One, five | |
| | | 595.Ls: Five past. | | |
| 31:10 | | 596.T: Five past. (Points at 2). | T: Five past. Two? | |
| | 31:12 | 597.Lp, Lt, Ls, Lph, Lz: Two is ten past. | Lt: Two, ten past. | |
| 31:14 | | 598.T: Ten past. (Points at 3). Three is quarter past. | T: Ten past. Three. Quarter past. | |
| | 31:14 | 599.Lp, Lt, Ls, Lph, : Three is quarter past. | Lt: Three, half past | |
| 31:17 | | 600.T: (Points at 4) Four is twenty past. | T: Four. Twenty past. | |
| | 31:18 | 601.Lt, Ls, Lph, Lz, Lol, Lan, La: Four is twenty past. | Lt: Four twenty past. | |
| 31:21 | | 602.T: (Points at 5) Five is twenty-five past. | T: Five. Twenty five past. | |
| | 31:22 | 603.La, Lan, Lol, Lz, Lph, Ls: Five is twenty five past. | | |
| 31:24 | | 604.T: (Points at 6) Six is half past. | T: Six. Half past. | Teacher changes 8=4 and 7=5 around. |
| | 31:25 | 605.La, Lan, Lol, Lz, Lph, Ls: Six is half past. | | |
| 31:28 | | 606.T: Good. Listen, listen. (Points at 1) One is the same as who? | T: Now . | |
| | 31:30 | 607.Ls, Lph: One. | Lt: One. | |
| | 31:33 | 608.Lt, Lph, Ls, Lp: Five past. | Lt: Five. | |
| 31:33 | | 609.T: Five. Yes, yes. Good. Hold onto that. One is the same as what? Five. | T: One fana nabani? *(One is the same as who?)* Five. | |
| | 31:40 | 610.Lph: Five past. | Lt, Ls: Five. | |
| 31:40 | | 611.T: The same as eleven is the same as who? Five. | T: Same, same eleven fana nabani? | |

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| | 31:44 | 612.Lph, Ls: Five. | Five. *(Eleven is the same as who? Five)* | |
| 31:47 | | 613.T: Two is the same as who? | T: Two fana nabani? *(Two is the same as who?)* | |
| | 31:48 | 614.LL: Ten! | | |
| | 31:49 | 615.Lph, Ls: Ten. | Lt: Ten! | |
| 31:50 | | 616.T: Ten. Good. The same as ten is the same as who? Ten. | T: Same, same ten fana nabani? *(Ten is the same as who?)* Ten. | |
| | 31:55 | 617.Lph, Ls: Ten. | | |
| 31:58 | | 618.T: (Points at 3). Three is the same as who? | T: Three fana nabani? *(Three is the same as who?)* | |
| | 32:00 | 619. | Lt: Half past. | |
| | 32:00 | 620.Lz: Fifteen, fifteen, quarter, quarter. | | |
| | 32:00 | 621.Ls: Nine, quarter, quarter, quarter past. | | |
| | 32:00 | 622.Lol: Nine. | | |
| | 32:00 | 623.Lph: Thirty past, thirty half, half past. | | |
| | 32:03 | 624.Lod, La: Quarter, quarter. | | |
| 32:01 | | 625.T: No, quarter, quarter, quarter. (Points at 9). Nine is the same as what? Three. | T: Nine uyafana nabani? Ngu-3. *(Nine is the same as who? Three.)* | |
| | 32:07 | 626.Lph, Ls: Three. | | |
| 32:09 | | 627.T: Quarter, quarter, quarter. | T: Quarter, quarter, quarter. | |
| | 32:09 | 628.Ls: Quarter, quarter. | Lt: Quarter, quarter | |
| 32:11 | | 629.T: (Points at 4). Four is the same as what? | T: Four fana nabani? *(Four is the same as what?)* | |
| | 32:12 | 630.Lph: Quarter, four past. | | |
| | 32:12 | 631.Ls: Quarter past. | Lt: Twenty five | |
| 32:14 | | 632.T: Oh no! | | |
| | 32:16 | 633.Lt: Twenty. | Lt: Twenty. | |
| 32:18 | | 634.T: Twenty, twenty, twenty. Yes. Twenty. The same as eight is the same as who? | T: Twenty, twenty, twenty. Yes, twenty. Same eight, eight fana nabani? *(Eight is the same as who?)* | |
| | 32:24 | 635. Lz: Twenty. | | |
| 32:25 | | 636.T: Twenty. (Points at 5). Five is the same as what? | | |
| | 32:28 | 637.Ls, Lt, Lz: Twenty five | Lt: Twenty. | |
| 32:30 | | T: Twenty five, twenty five, twenty five. It is the same, same, same. Seven is the same as what? Twenty five. [*It is not explicit why seven, which was previously thirty five, is now twenty five*]. | T: Twenty, twenty. Five fana nabani? *(Five is the same as who?)*<br>Lt: Twenty five.<br>T: Twenty five, twenty five, twenty five. Same, same, same, same. Seven fana nabani? *(Seven is the same as who?)* Twenty five. | |
| | 32:36 | 638.Ls, Lz: Twenty five. | Lt, Ls: Twenty five. | |
| 32:38 | | 639.T: (Points at six). Six is the same as what? | T: Six fana nabani? *(Six is the same as who?)* | |
| | 32:40 | 640.Lt: Thirty, thirty, half. | Lt: Thirty, half. | |

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| | 32:40 | 641.Lp, Lph, Ls: Half, half, half. | | |
| 32:42 | | 642.T: Half, half. (Points at 12) Twelve is o'clock, twelve o' clock. | T: Twelve…twelve…twelve. Heke *(yes).* | |
| | 32:46 | 643.Lt, Lp, Ls, Lph: O'clock. | | |
| 32:52 | | 644.T: Now (refers to clock drawn on the board). Remember this side (indicates left side of clock) is to, to, to, to. | T: Now. Remember…. To, to, to, to… past, past, past. | |
| | 32:56 | 645.Lt, Ls, Lph: To, to, to. | Lt: To, to, to, to. | |
| 32:59 | | 646.T: This side (indicates right side of clock) is past, past, past, past. I see you are clever. You all know it. | | |
| | 32:58 | 647.Lt, Ls, Lph, Lz, Lol: Past, past, past, past. | Lt: Past, past, past. | |
| 33:08 | | 648.T: Now (Points at 7 on clock). What is this? | | |
| | 33:11 | 649.Lph: Thirty five past. | Lph: Thirty five. | |
| | 32:12 | 650.Lt: Three. | Lt: Thirty five, thirty five. | |
| 33:12 | | 651.T: Remember, remember seven is the same as who? | T: Good. Remember seven fana nabani? *(Seven is the same as who?)* | |
| | 33:16 | 652.Lt: Thirty five, thirty five. | Lt: Three five to, to. | |
| | 33:16 | 653.Ls: Half, thirty, thirty five. | | |
| | 33:16 | 654.Lph: Twenty five. | Lph: Twenty five, twenty five, twenty five. | |
| | 33:16 | 655.Lp: Thirty. | | |
| 33:18 | | 656.T: (Points at Lt). Good, good, good. Remember seven is the same as what? Twenty five, twenty five, twenty five. Remember, we said five (points at 5 written on board) is the same as twenty five and 7 (points at 7 on board) is also the same as twenty five. | T: Twenty five to, twenty five to. | |
| 33:35 | 33:33 | 657.Lp: Oh! I was confused. (Points at clock). | | |
| | 33:35 | 658.Lph: I'm confused. [*Learners are confused by the ambiguous criteria*]. | | |
| 33:36 | | 659.T: (Points at 7 on clock). Seven is who? | | |
| | 33:37 | 660.Lt: Thirty five to, to. | | |
| | 33:37 | 661.Lph: Twenty five, twenty five past. | Lph: Twenty five to. | |
| | 33:37 | 662.Ls: Thirty five, thirty five to. | | |
| 33:39 | | 663.T: Twenty five to, twenty five to. | | |
| | 33:42 | 664.Lt: Thirty five to, thirty five to. | | |
| | 33:42 | 665.Lp: Thirty five to. | | |
| | 33:42 | 666.Lph, Lz: Twenty five to. | | |
| 33:44 | | 667.T: No, no (to Lt). Twenty five to, twenty five to. | | |
| | 33:44 | 668.Lt: Twenty five to. | | |
| 33:49 | | 669.T: No, no (to Lp). Twenty five to, twenty five to. | | |
| | 33:45 | 670.Lt, Ls, Lph, Lz: Twenty five to, twenty five to, twenty five | | |
| 33:55 | | 671.T: (Points at 8 on clock). Who is eight? | T: Eight ngubani? *(Who is eight?)* | |
| | 33:58 | 672. | Lt: Forty. | |
| | 33:58 | 673.Lph: Four, four. [*Teacher's criterion was that 8=4*]. | | |
| 34:00 | | 674.T: Leave that, leave it, leave it. Remember we said. Who is four? | T: Leave, leave, leave. Remember, remember ndithe four ngubani? *(I* | |

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| | 34:05 | 675.Lz: Eight. | *said four is who?)* | |
| | 34:05 | 676.La, Lph: Twenty. | | |
| 34:05 | | 677.T: Twenty. Remember we said it's the same. Eight is the same as eighty[31]. | T: Twenty. Same, same, same eight fana nabani? *(Eight is the same as who?)* Twenty. | |
| | 34:09 | 678.Lt: Eighty. | | |
| | 34:09 | 679.Ls: Twenty. | | |
| | 34:10 | 680.Lp: Twenty. | | |
| 34:11 | | 681.T: Now (Points at 8 on clock) who is this? | T: Now, ngubani ke ngoku? *(Who is this now?)* | |
| | 34:12 | 682.Lt: Eighty to, eighty to[32]. | Lt: Twenty to, twenty to. | |
| | 34:13 | 683.Ls, Lph: Twenty to. | | |
| 34:14 | | 684.T: Good (Points at Lt)! Twenty to, twenty to. | T: Good! Twenty to, twenty to. Heke *(yes).* | |
| | 34:17 | 685.Lt, Ls, Lph, Lz: Twenty to, twenty to. | Lt: Twenty to, twenty to. | |
| 34:19 | | 686.T: (Points at 9 on clock) nine is the same as who? (Indicates right side of the clock). | T: Nine, nine, fana nabani? *(Nine is the same as who?)* | |
| | 34:22 | 687.Lt: Twenty five, quarter, quarter, to. | Lt: Twenty five. | |
| | 34:22 | 688.Ls: Five to past. | | |
| | 34:22 | 689.Lph: Ten to five. | | |
| | 34:24 | 690.Lp: Fifteen, fifteen, fifteen. | | |
| | 34:26 | 691.Lph: Twenty four. | Lph: Twenty five. | |
| | 34:27 | 692.Ls: Ten, ten, ten. | Lph: Twenty four. | |
| | 34:27 | 693.Lt: Eighty, fifteen, half. | Lt: Twenty, fifteen, half. | |
| 34:31 | | 694.T: Quarter, quarter, quarter, quarter. Who is the same as this (points at 9)? | | |
| | 34:29 | 695.Ls: Half, half, quarter, quarter, quarter to. | | |
| | 34:30 | 696.Lt, Lph: Quarter, quarter. | | |
| | 34:33 | 697.Lt: Quarter to, quarter to, quarter to. | Lt: Half to, half to, half to. | |
| 34:36 | | 698.T: Quarter, quarter. No, not half. It is quarter, quarter, quarter. (Points at 9 on clock). Quarter to, quarter to. | T: No, not i-, not i-half, quarter, quarter, quarter, quarter. Quarter to, né quarter to. | |
| | 34:39 | 699.Lt, Lph, Lp, Lz, Lol: Quarter to, quarter to. | Lt: quarter to, quarter to. | |
| 34:49 | | 700.T: (Points at ten on clock). It's the same as who? | | |
| | 34:54 | 701.Lp, Lt, Ls, Lph, Lz: Ten. | | |
| 34:55 | | 702.T: Ten, ten, ten is the same as what? Ten! Who? | | |
| | 34:56 | 703.Lt, Lp, Ls, Lph: Ten to, ten to. | Lt: Ten to | |
| 35:00 | | 704.T: Yes, ten to, ten to. | | |
| | 35:01 | 705.Lt, Ls, Lph, Lz, Lp: Ten to, ten to. | Lt: Ten to. | |
| 35:05 | | 706.T: (Points at 11 on clock). Eleven is the same as who? | T: Eleven fana nabani? *(Eleven is the same as who?)* | |
| | 35:07 | 707.Lph: Five. | Lph: Five. | |

[31] Teacher signs "eighty" instead of "twenty" which confuses a learner.
[32] Learner uses the incorrect sign used by the teacher. She produces the required response in her speaking.

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|---|---|---|---|---|
| | 35:08 | 708.Lp: Five. | | |
| | 35:08 | 709.Lt: O'clock, five. | Lt: Twelve, five to. | |
| | 35:10 | 710.Ls, Lz: Five. | | |
| 35:09 | | 711.T: Five, five. Now, who? Five to, five to. | T: Five. Now, ngubani? *(Who?)* Five to, five to | |
| | 35:12 | 712.Lp, Lt, Ls, Lph, Lz: Five to. | Lt, Lph: Five to, five to. | |
| 35:17 | | 713.T: (Points at 12). | | |
| | 35:17 | 714.Lol, Lod: O' clock. | | |
| | 35:18 | 715.Lz, Lph, La: O' clock, o'clock. | | |
| 35:19 | | 716.T: O'clock, o'clock, o'clock. Good. | | |

**Criteria:**

- The numbers on the clock that are symmetrically opposite each other are equal.
- The same term to describe the number of minutes past the hour can be used to describe the number of minutes to the hour. These criteria are implicit. The teacher's conceptualisation is that the numbers are the same when making statements about the time, not necessarily as being equal mathematically. Fragments of the conventions are the same, i.e. five past, five to where both statements consist of five.
- The teacher states that 6 = 12; however the same terms are not used to describe these numbers on the clock. It is possible that she included these numbers as she would not be able to explain why they shouldn't be included.
- When describing 3 on the clock, omit 15 and use quarter only.
- When describing 9, omit 45 and use quarter only.
- It is implicit that these descriptions are used based on the position of the minute hand.

**Comments:**

The learners appear confused between the previous and restated criteria.

## Evaluative Event 4: Describing the time using examples

### Evaluative Event 4.1: Example 1: Quarter to ten

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 35:23 | | 717.T: Now… (Erases writing from the board. She draws three clocks on the board). | T: Now… | |
| | 35:31 | 718.(The learners chat while the teacher writes on board). | | |
| 37:33 | | 719.T: Now, listen, do you see? (Points at clock 2) The hour, the time is at three. I want you to tell me what is the time here? (Points at clock 1), what is the time | T: Now, ne siyabona… *(we see)* | |

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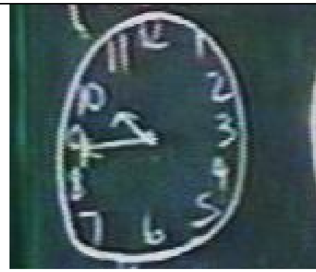
|---|---|---|---|---|
| | | here? (Points at clock 2) and what is the time here? (Points at clock 3). | |  |
| 37:51 | | 720.Lp: (Nods). | | |
| 37:52 | | 721.T: Do you see (points at long hand on first clock) the tall one? Do you see it? Who is the tall one? Who? | | |
| | 37:55 | 722.Ls: The long one is at nine. | | |
| | 37:57 | 723.Lod, Lph: The long one. | | |
| 37:59 | | 724.T: Who is this (points at the long hand on Clock 1)? | | |
| | 37:59 | 725.Ls, Lt: Nine. | | |
| 38:00 | | 726.T: Nine. (Points at short hand) who is the short one? | | |
| | 38:01 | 727.Lt: The short one. | | |
| | 38:00 | 728.Lp, Lph, Ls: Ten. | Lph: Ten | Clock 1 |
| 38:03 | | 729.T: Ten. Good. (Points at long hand on Clock 2). Who is the tall one? | | |
| | 38:04 | 730.Ls: O'clock, o'clock. | | |
| | 38:05 | 731.Lt: Twelve. | Lt: Twelve. |  |
| 38:07 | 38:06 | 732.Lph: Twelve. | Lph: Twelve. | |
| | | 733.T: Twelve. Who is the short one? | T: Twelve. Futshane *(short)*? | |
| 38:07 | 38:07 | 734.Lt: The short one is at three. | Lt: Futshane *(short)* three. | |
| | 38:07 | 735.Ls, Lph: Three. | | |
| | 38:07 | 736.Lp: Two, no three. | | |
| 38:10 | | 737.T: Three. Who is the tall one here (points at Clock 3)? | | |
| | 38:12 | 738.Lp, Lt, Ls, Lph: One. | Lt: One. | |
| 38:14 | | 739.T: One. The short one? | Lt: Futshane *(short)* two. | |
| 38:15 | 38:12 | 740.Lp: Two. | | |
| | 38:14 | 741.Lt, Ls, Lph: Two. | | |
| 38:16 | | 742.T: Two. Now, what is the time here? (Points at Clock 1). | | Clock 2 |
| | 38:21 | 743.Lph: Nine. | Lph: Nine. | |
| 38:22 | | 744.T: Remember, remember, who is nine? | | |
| | 38:26 | 745.Lph: Ten… ten. | Lph: Ten…ten. |  |
| 38:27 | | 746.T: No, Remember, nine stands for who? | | |
| | 38:31 | 747.Lph: Ten nine, nine, o'clock. | Lph: Ten, nine, nine. | |
| | 38:32 | 748.Lt: O'clock, no… | | |
| | 38:33 | 749.Lz: Ten, ten, ten. | | |
| 38:34 | | 750.T: First, remember nine stands for who? | | |
| | 38:39 | 751.Lph: Eight. | Lph: Eight. | |
| | 38:39 | 752.Lz: Ten. | | |
| | 38:41 | 753.Lol: Ten. | | |
| 38:42 | | 754.T: (Walks towards the clock drawn initially and points at the nine) Remember, who is it? | | |
| | 38:44 | 755.Lt, Lp, Ls, Lph: Forty five. | Lt, Lph: Forty five. | Clock 3 |
| | 38:47 | 756.Lt, Ls: To. | Lt: To. | |
| 38:49 | | 757.T: (Points at Lt). | | |
| | 38:48 | 758.Lt: Forty five to. | Lt: Forty five to. | |
| | 38:50 | 759.Lph: Forty five to. | Lph: Forty five to. | |

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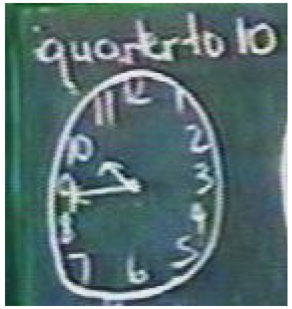
|---|---|---|---|---|
| 38:51 | | 760.T: Forty five to…no, no leave that. Quarter… [Teacher produces the required response]. | | |
| | 38:52 | 761.Lp: Forty five. | | |
| | 38:53 | 762.Lt: To, to. | | |
| | 38:54 | 763.Lt, Ls: Quarter, quarter, quarter, quarter to, quarter to. | | |
| | 38:56 | 764.Lz: Quarter to, quarter to, quarter to. | | |
| 38:55 | | 765.T: Quarter to, quarter to. Yes. (Points at first clock). Who is this? What is the time there? | | |
| | 39:04 | 766.Lph: Nine. | Lph: Nine. | |
| 39:05 | 39:05 | 767.Lp: Fifty, fifty. | | |
| 39:07 | | 768.T: What is the time here? (Points at clock 1) What is it? | | |
| | 39:10 | 769.Lol: Forty five. | | |
| | 39:12 | 770. | Lt: Forty five. | |
| | 39:13 | 771.Lph: Fifty, fifty, fifteen. | Lph: Fifty, fifty, fifty. | |
| | 39:11 | 772.Lan: Five, quarter past. | |  |
| | 39:17 | 773.Ls: Ten, ten, ten. [*Learners are unable to produce the required response*]. | | |
| 39:18 | | 774.T: What is the time? (Points at first clock). What is the time? Who? | | |
| | 39:21 | 775.Lph: Nine. | Lph: Nine. | |
| | 39:21 | 776.Lol: Forty five to, forty five to, quarter. | | |
| | 39:21 | 777.Lan: The time is nine. | | |
| | 39:21 | 778. | Lt: Five. | |
| | 39:22 | 779.Lz: Ten, ten, to, quarter, quarter to ten. | | |
| | 39:24 | 780.Lph: Fifty, fifty. | Lph: Fifty, fifty. | |
| 39:26 | 39:27 | 781.T: (Points at Lz). Say that again. | T: Again. | |
| | 39:29 | 782.Lz: Quarter to ten. [*This learner produces the required response*]. | | |
| 39:31 | 39:31 | 783.T: That's it! Good. (Writes on board). Quarter to ten. Good. | T: Good. | Teacher writes the time in words. |
| | 39:48 | 784.Lt, Ls, Lph, Lz: Quarter to ten. | Lt: Quarter to ten. | |

**Criteria:**

- It is implicit that the learners need to consider the long hand in relation to the short hand in order to tell the time.
- The criteria to describe the time are too implicit and ambiguous which confuses the learners.

**Comments:**

The learners are unable to produce the required response and the teacher provides the correct term.

**Evaluative Event 4.2: Example 2: Three o' clock**

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 39:50 | | 785.T: (Points at Clock 2). Who is it? | |  |
| | 39:51 | 786.Lod: Twelve, twelve, twelve to. | | |
| | 39:53 | 787.Lph: Quarter to three. | | |
| | 39:54 | 788.Lz: Three, three. | | |
| 39:56 | | 789.T: What is the time here (points at second clock)? What is the time? | | |
| | 39:59 | 790.Lph: Thirty five. | | |
| | 39:59 | 791.Lol: …Three. | Lph: Thirty five | |
| 40:01 | | 792.T: (Points at Lol). You know a little bit. Who is it? | | |
| | 40:04 | 793.Lph: Twenty past, twenty past. | | |
| | 40:05 | 794.Ls: Quarter past, quarter past. | | |
| 40:06 | | 795.T: Remember, (points at 12 on clock 2) who is this? | T: Remember, remember… | Clock 2 |
| | 40:09 | 796.Lp, Lt, Ls, Lz: O'clock, o'clock. | | |
| | 40:09 | 797.Lph: Twelve o'clock. | | |
| 40:09 | | 798.T: O'clock, yes, o'clock. What is this? (Points at second clock). | T: O'clock, yes, o'clock. Ngubani? | |
| | 40:13 | 799.Ls: Quarter…quarter past, quarter past, quarter past three. | *(Who is it?)* | |
| | 40:13 | 800.Lph: Twenty past. | | |
| | 40:16 | 801.Lod: Half…twenty, half twelve. | | |
| | 40:18 | 802.Lt: Quarter, quarter… half past. | Lt: Half, half, half…half past | |
| 40:19 | | 803.T: (Shakes her head). | | |
| | 40:24 | 804.Ls: Quarter, quarter, quarter past. | | |
| | 40:26 | 805.Lp: Quarter to. | | |
| 40:28 | | 806.T: Remember, we said o'clock, o'clock, o'clock. Yes! O'clock who is that? (pointing to clock). | T: Remember… o'clock, o'clock yes. O'clock… | |
| | 40:32 | 807.Lol: To twelve. | | |
| | 40:32 | 808.Lod: Two. | | |
| | 40:32 | 809.Lph: Twenty o'clock. | | |
| | 40:33 | 810.Lz: Twenty, twenty, twenty. | | |
| 40:35 | | T: Who is this? (Points at short hand on clock 2). Who is the short one? [*The difference in length between the short and long hands is not explicitly shown in the drawing which seems to create confusion*]. | T: Ngubani lo? Futshane, futshane ngubani? *(Who is this? Short, short who is it?)* | |
| | 40:37 | 811.Lz: The short one… | | |
| | 40:37 | 812.Ls: The short one is at three past. | | |
| | 40:37 | 813.Lp: Fifteen, fifteen. | | |
| | 40:40 | 814.Lt: Three. | Lt: Three. | |
| 40:40 | | 815.T: Three. Who is the long one? | T: Ngu-three. Ende ngubani? *(It's three. The long one is who?* | |
| | 40:43 | 816.Lt: O'clock, twelve. | | |
| | 40:43 | 817.Ls: O'clock. | | |
| | 40:44 | 818.Lp: Twelve. | | |
| 40:44 | | 819.T: O' clock, o'clock. What is the time? | T: Ngubani i-time? *(What is the* | |

| | | | | |
|---|---|---|---|---|
| | 40:49 | 820.Lan: …To, past. | *time?)* | |
| 40:49 | | 821.Lp: Sixty, sixty. | | |
| 40:50 | | 822.Lt: Sixty. | Lt: sixty | |
| 40:51 | | 823.T: Remember we said this is o'clock (Points at long hand on clock). Yes. | T: Remember, nditsho ukuthi lena i-o'clock ewe. *(I was saying this is o'clock. Yes).* | |
| | 40:50 | 824.Lph: Quarter to. | | |
| | 40:53 | 825. | Lt: Sixty. | |
| | | 826.T: Who is this (points at short hand on clock)? | T: Lena ngubani? *(Who is this?)* | |
| 40:55 | 40:56 | 827.Lph: O'clock past thirty. | | |
| | 40:57 | 828.Ls: Past three, past three, quarter past, quarter past. | | |
| | 40:57 | 829.Lt: Past. | | |
| 40:57 | 40:57 | 830.Lp: The short one, short one, short one. | | |
| | 41:02 | 831.Lan: Past, past, past. | | |
| | 41:02 | 832.La: Half…to. | | |
| | 41:02 | 833.Lol: Fifteen to, fifteen. | | |
| 41:05 | | 834.T: (Points at short hand on clock 2). The short one, short one? | | |
| | 41:06 | 835. | Lt: Half. | |
| | 41:06 | 836.Lo: Sixteen, nought, sixteen nought. | | |
| 41:11 | | 837.T: Remember we said this (points at long hand) is o'clock, o'clock, o'clock. (Points at short hand). Who is this? | T: O'clock, o'clock, o'clock, o'clock. Lena ngubani? *(Who is this?)* | |
| | 41:17 | 838.Lph: o' clock, twenty to past. | | |
| 41:19 | | 839.T: Who is the short one? Who is the short one? | T: Efutshane, futshane ngubani? *(The short one, short one is who?)* | |
| | 41:24 | 840.Lt, Ls: Three. | Lt: three. | |
| 41:24 | | 841.T: Three, three. Yes. Where is the long hand? | T: Three, three. Ende ngubani? *(The long one is who?)* | |
| 41:28 | 41:27 | 842.Lph, Lz, Lan: Twelve. | Lt: Twelve. | |
| | 41:30 | 843.Lp: Twelve. | | |
| 41:28 | | 844.T: Twelve, twelve, twelve. Twelve stands for who? | T: Twelve, twelve, twelve. Twelve mile bani? *(Twelve stands for who?)* | |
| 41:29 | 41:33 | 845.Lp: Sixty. | | |
| | 41:33 | 846.Ls: O'clock, twelve, twelve. | | |
| | 41:33 | 847.Lph: Past. | | |
| | 41:33 | 848.Lz: Six, quarter six, Sixty, sixty, sixty. | | |
| 41:34 | | 849.T: Twelve stands for who? | T: Twelve umele bani? *(Twelve stands for who?)* | |
| | 41:38 | 850.Lp: O'clock, o'clock. | | |
| | 41:39 | 851.Lph: Four, ten. | Lph: Ten. | |
| | 41:39 | 852.Lz: O'clock. | | |
| 41:35 | 41:41 | 853.Ls: Past three. | | |
| 41:38 | 41:41 | 854.Lt: Sixty to. | Lt: Sixty to. | |
| | 41:43 | 855.Lz: Sixty, sixty, sixty. | | |
| | 41:35 | 856.Lph: O'clock, o'clock. | | |
| | 41:46 | 857.Lt: Sixty to. | Lt: Sixty to. | |
| | 41:48 | 858.Ls: O'clock, o'clock. | | |

| | | | | |
|---|---|---|---|---|
| | 41:52 | 859.Lph: Three, three. | Lph: Three, three. | |
| 41:49 | | 860.T: (Points at Lph) three what, three what? | T: Three ntoni, three ntoni? *(Three what? Three what?)* | |
| | 41:56 | 861.Lph: Thirty three past | | |
| 41:54 | | 862.T: Three what? | T: Hmm? Three ntoni? *(Three what?)* | |
| | 41:57 | 863.Lph: The short one is at three. | | |
| | 41:58 | 864.Lz: Five. | | |
| | 42:02 | 865.Lz: One | Lt: Ten | |
| 42:01 | | 866.T: (Points at clock 2). Three o'clock, three o'clock, three o'clock. Okay. [*Teacher produces required response as learners are unable to*]. | T: Three o'clock, three o'clock, three o'clock. Siyavana? *(Do you agree?)* | |
| | 42:05 | 867.Lt, Lz, Ls, Lph: Three o' clock, three o'clock, three o'clock | | |

**<u>Criteria</u>:**
Learners are unable to produce the required response due to the teacher's implicit and ambiguous criteria.

**<u>Comments</u>:**
Learners seem to be guessing at the required description as the criteria were implicit and ambiguous. The teacher encourages learners to guess and call out answers.

### Evaluative Event 4.3: Example 3: Five past two

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 42:10 | | 868.T: (Points at clock 3). Who is this? Remember (points at the long hand) Who is this? | T: Ngubani? *(Who is it?)* |  Clock 3 |
| | 42:11 | 869.Ls: One. | | |
| | 42:11 | 870.Lol: Two, two. | | |
| | 42:13 | 871.Lt: It's big. | Lt: One. | |
| | 42:14 | 872.Lph, Lz, Lp: One. | | |
| 42:15 | | 873.T: What does one stand for? | T: One umela ntoni? *(One stands for what?)* | |
| | 42:16 | 874.Lt: Five. | Lt: Five, five. | |
| | 42:16 | 875.Ls, Lz: Five. | | |
| | 42:16 | 876.Lph: Two. | | |
| 42:18 | | 877.T: Five, five. (Points at 2) That's two. (Points at long hand). This is the long hand for minutes (ticks). The short one stops. It stops. | T: Five, five. Two ne le ende nè for… *(This long one ne for…)* | |
| 42:29 | 42:29 | 878.Lt, Ls, Lz: Stop. | Lt: Stop! | |
| 42:31 | | 879.T: (Points at third clock) What is the time? | | |
| 42:35 | 42:33 | 880.Lp: The time is two, quarter ten, ten, ten. | | |
| | 42:34 | 881.Lph: Twenty five. | Lph: Twenty five, twenty five. | |
| | 42:34 | 882.Ls: Fifteen past, fifteen, twenty to, twenty to ten to ten, ten, ten. | | |

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|---|---|---|---|---|
| | 42:37 | 883.Lt: Ten half. | Lt: Ten half. | |
| 42:38 | | 884.T: Remember, (points at right side of clock). What is this? (Points at right side of clock) | | Criteria:<br>▪ The right side of the clock is past |
| | 42:40 | 885.Lp: Ten, ten. | | |
| | 42:40 | 886.Ls: Quarter past, quarter past. | Lt: Past, past, past. | |
| 42:42 | 42:40 | 887.Lt: Past, past, past. | | |
| 42:43 | | 888.T: Past, past, past. Yes! Past, past, past, past. | T: Past, past, past. Yes! Past, past, past. Yes. | |
| | 42:43 | 889.Lt, Ls, Lz: Past, past, past. | | |
| 42:47 | | 890.T: (Points at clock). Who is this? | T: Ngubani? *(Who is it?)* | |
| | 42:51 | 891.Lz: Ten past two, ten past two. | | |
| | 42:52 | 892.Lph: Twenty five past. | | |
| | 42:52 | 893.Lol: Past one, two past. | | |
| | 42:53 | 894. | Lt: Ten past. | |
| | 42:54 | 895.Ls: Fifteen, fifteen, fifteen past, fifteen, fifteen past. | | |
| | 42:55 | 896.Lt: Ten past. | Lt: Ten past. | |
| 42:53 | | T: (Looks at Lz) It's just a little right. No. A little bit. No. [*Certain elements in her response are correct*]. | | |
| | 42:57 | 897.Lt: Ten to. | Lt: Ten to. | |
| 43:00 | | 898.T: No (to Lt). | | |
| | 42:58 | 899.Ls: Fifteen, fifteen past. | | |
| | 42:59 | 900.Lt: Ten half. | Lt: Ten half. | |
| | 43:00 | 901.Lph: Twenty, twenty. | Lph: Twenty, twenty. | |
| 43:02 | | 902.T: (To Lz).It's just a little bit. Try again. You try again. | | |
| | | 903.Lp: Ten past, ten past. | | |
| | 43:07 | 904.Lph: Twenty five past. | Lph: Twenty five. | |
| | 43:07 | 905.Ls: Quarter past, quarter, quarter, quarter | | |
| 43:10 | | 906.T: No (to Lp). | | |
| | 43:09 | 907.Lt: Past ten, past ten. | Lt: Past ten, past ten. | |
| 43:12 | | 908.T: No (to Lt). | | |
| | 43:12 | 909.Lz: Ten past. | | |
| | 43:13 | 910.Lo: Five past, five past. | | |
| 43:13 | | 911.T: (Points at Lod) Who is it? | | |
| | 43:14 | 912.Lod: Five past. | | |
| | 43:17 | 913. | Lt: Five past. | |
| | 43:17 | 914.Lz: Five. | Lz: Five. | |
| 43:19 | | 915.T: Five past who? | T: Five past bani? *(Five past who?)* | |
| | 43:20 | 916.Lz: Ten. | | |
| | 43:21 | 917.Lo: Five past five | | |
| | 43:21 | 918. | Lt: Five past. | |
| 43:24 | | 919.T: Where is the short one? | T: Efutshane ngubani? Ngubani**?** *(The short one is who? Who?)* | |
| | 43:23 | 920.Lod: The short one? | | |
| | 43:24 | 921.Lol: Past five. | | |

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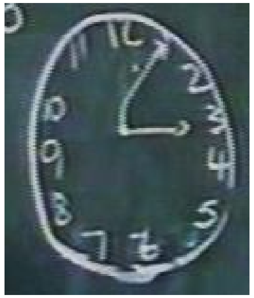
| | 43:25 | 922.Lz: Two. | | |
| | 43:25 | 923.La: Ten to. | | |
| | 43:25 | 924.Lan: Ten, ten, ten. | | |
| 43:25 | | 925.T: You, Odwa, where is the short one? | T: Yima, Odwa. Efutshane ngubani? *(Wait, Odwa. The short one is who?)* | |
| | 43:27 | 926.Lo: The short one is at two. | | |
| 43:28 | | 927.T: Two. Yes. And the long one? | T: Two, ewe *(yes)*. Ende ngubani? *(The long one is who?)* | |
| | 43:31 | 928.Lo: One, ten. | | |
| 43:33 | | 929.T: One. Which means? | T: One. Which means ngubani? *(Who?)* | |
| | 43:36 | 930.Lph: Five. | Lph: Five. | |
| 43:36 | | 931.T: Five. Yes. What is the time? | T: Five. Yes. So ngubani ke ngoku u-time? *(So now, what is the time?)* | |
| | 43:39 | 932.Ls: Fifteen, fifteen. | | |
| | 43:39 | 933.Lph: Five, five past. | Lph: Five. | |
| | 43:45 | 934.Lz: Five. | Lz: Five. | |
| 43:45 | | 935.T: Yes, five, five past who? | T: Heke *(yes)*! Five past ngubani *(who)*? | |
| | 43:48 | 936.Ls: One. | | |
| | 43:48 | 937.Lz: Five past two. | | |
| | 43:49 | 938.Lph: O'clock. | | |
| 43:51 | | 939.T: That's it! Good! Five past two. Five past two. | T: Nantso, nje na! *(There you got it!)* Good. Five past two. Five past two. | |
| | 43:58 | 940.Lt, Lz: Five past two. | Lt: Five past two. | |

**<u>Comments</u>:**
The learners produce the required response through guessing the criteria until the appropriate response is made.

## Evaluative Event 5: Describing the time when the minute hand changes at five minute intervals past the hour

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 44:00 | | 941.T: Now, ok, ok. (Points at clock 2). Listen. We said three o'clock, three o'clock. | T: Now, ok, ok. Besithe *(we had said)* three o'clock ne, three o' clock. |  |
| | 44:09 | 942.Lt, Lph: Three o'clock. | Lt: Three o' clock. | |
| 44:11 | | 943.T: Now. Again. (Wipes out the long hand and redraws it pointing to 1 on the clock) what is the time? | T: Now le *(this)* again le *(this)*... Ngubani lo xesha? *(What is this time?)* | |
| | 44:23 | 944.Lod: Six. | | |
| | 44:23 | 945.Lan: One past | Lph: One, one. | |
| | 44:23 | 946.Lol: Past two, past two past two (tries to get teacher's attention) | | |
| | 44:24 | 947.Lph: One. | Lph: One. | |
| | 44:25 | 948.Lod: Past six. | | Clock 2 |
| | 44:25 | 949.Lz: One, five. | | |
| | 44:26 | 950. | Lt: Three, thirty five. | |
| 44:27 | | 951.T: What is the time? | |  |
| | 44:29 | 952.Lz: Five past three, five past three. | | |
| | 44:30 | 953.Lph, Ls: Five, five, five. | Lph: Five, five, five. | |
| 44:32 | | 954.T: (Points at Lz). | T: Nantsiya *(There it is).* | |
| | 44:34 | 955.Lz: Five past three. | | |
| | | 956.Lph: Three past. | Lph: Three. | |
| 44:38 | | 957.T: Five past three. | T: Five past three okay. | |
| | 44:39 | 958.Lz, Lph: Five past three, okay. | | |
| 44:43 | | 959.T: (Wipes the long hand from the clock and draws the arrow pointing to the two). | T: Now, again. Phindi mov(e) *(It moves again).* | |
| 44:54 | | 960.T: Now, don't you tell (pointing to Lz). What is it now? What is the time? (Points at clock). Again it ticks. Ten who? What is the time? | T: Now, ngubani ke ngoku? Ngubani ixesha? Phindile. Ten ngubani? Ixesha? *(Now, who is it? What is the time? Again. Ten who? Time?)* | Teacher changes the position of the minute hand to 1 on the clock. |
| | 45:03 | 961.Lol: Past ten three. | | |
| | 45:04 | 962.Lan: Ten past, ten past. | | |
| | 45:04 | 963.Lod: Three past two. | | |
| | 45:05 | 964. | Lt: Three past two. | |
| 45:08 | | 965.T: No (to Lt). | T: Hayi *(no).* | |
| | 45:08 | 966.Lan: Ten past, ten… | | |
| | 45:10 | 967.La: Two. | | |
| | 45:12 | 968.Lol: Past ten three. | Lt: Two. | |
| 45:12 | | 969.T: (To Lol) say that again. No, change it around a little again and it will be | | |

| | | | | |
|---|---|---|---|---|
| | | right. [*Learner needs to change the order of the elements making up his response*]. | |  The position of the minute hand is changed to 2. |
| | 45:12 | 970.Lan: Ten past ten. | | |
| | 45:13 | 971.Lz: Ten past three, ten past three. | | |
| | 45:15 | 972.Lod: Three past three. | Lt: Two past three. | |
| | 45:15 | 973.Lol: Three past ten, three. | | |
| | 45:16 | 974.La: Ten past five. | | |
| | 45:19 | 975.Lod: Three. | | |
| | 45:20 | 976.Lz: Ten past three. | | |
| | 45:23 | 977.Lt: …three, no, two past three. | Lt: …Three. Two past three. | |
| | 45:25 | 978.Ls: Two past three. | | |
| | 45:26 | 979.Lph: Past, twenty past. | | |
| 44:29 | | 980.T: No. | | |
| | 45:28 | 981.Ls: Two past three. | | |
| | 45:28 | 982.Lph: Five past. | Lph: Five | |
| | 45:29 | 983.Lt: Fifteen past. | Lt: Fifteen past three. | |
| | 45:30 | 984.Lz: Ten past three. | | |
| | 45:32 | 985.Ls: Past fifteen. | | |
| 45:33 | | 986.T: It's always, always, always Zintle who listens. It's always her who knows. Who is it? | T: Qho, qho, qho. Mamelani, qho, qho U-…uyayazi. Uthi ngubani? *(Always, always, always. Listen, always, always… she always knows it. She says who?)* | |
| | 45:39 | 987.Lz: Ten past three. | | |
| | | 988.T: Who is it? Who is it? | T: Ngubani? *(Who?)* | |
| | 45:43 | 989.Lz: Ten past three. | | |
| 45:44 | | 990.T: Yes, ten past three. | T: Ewe *(yes)*. Ten past three. | |
| | 45:44 | 991.Lol: Ten past, she copied me!! She copied me. | | |
| 45:49 | | 992.T: Who is copying? | T: Kopa ngubani? *(Who is copying?)* |  The clock hand is re-positioned at 3. |
| | 45:50 | 993.Lo: She did! (Pointing at Lz). | | |
| 45:52 | | 994.T: (Wipes the long hand from the clock). Again. (Redraws arrow pointing to 3) what is the time now? | T: Now, again. Ngubani ke ngoku u-time? Ngubani ixesha? *(Who is it now the time? What is the time?)* | |
| | 46:05 | 995.Ls: Ten past. | | |
| | 46:05 | 996.Lan: Three past, three past. | | |
| | 46:06 | 997.Lt: Ten…three. | Lt: Ten past three. | |
| 46:08 | | 998.T: That's finish, finish, finish. | T: Hayi *(no)*, finish, finish, finish. | |
| | 46:10 | 999.Lz: Fifteen, fifteen, quarter. | | |
| | 46:12 | 1000. Lph: Fifteen. | Lph: Fifteen. | |
| 46:11 | | 1001. T: (To Lz) Don't tell, wait, don't tell. | T: Uh, uh. | |
| | 46:12 | 1002. Lt: Fifteen quarter fifteen. | Lt: Fifteen half fifteen. | |
| | 46:13 | 1003. Ls: Quarter, quarter, quarter. | | |
| | 46:17 | 1004. Lph: Fifteen. | | |
| | 46:17 | 1005. Lod: Six past. | | |
| 46:17 | | 1006. T: No. Why, why? Fifteen, quarter, fifteen, why? Two. | T: Why, why? Fifteen, fa, fifteen, | |

| | | | | |
|---|---|---|---|---|
| | | | why? Two. | |
| | 46:21 | 1007. Lt: Oh no, quarter to. | Lt: Half to. | |
| | 46:21 | 1008. Lp: It's one. Quarter, quarter past, quarter past. | | |
| | 46:22 | 1009. Lph: Twenty five to. | Lph: Twenty five. | |
| 46:24 | | 1010. T: Remember I said if… | T: Remember ndithe if uthi… *(I said if you say…)* | |
| | 46:24 | 1011. Lt: Quarter past. | Lt: Half past. | |
| 46:27 | | 1012. T: Wait, wait… remember I said if it's fifteen, it's fifteen past only. If its quarter, it's quarter past only. You cannot say fifteen quarter past. No! Remember to use only one. If you say fifteen past, that's good! You cannot say fifteen, quarter past. If you say quarter past, that's good. One only. If you say quarter, what do you leave out? Fifteen. If you say fifteen, what do you leave out? Quarter. Ok, what is the time? (points at clock) | T: Remember, remember ndithe *(I said)* if uthi *(you say)* fifteen, fifteen past qha *(only)*! if uthi *(you say)* quarter, quarter past qha *(only)*! Not ififteen, quarter past. No! Remember ndithe sebenzisa *(use)* one. If uthi *(you say)* fifteen, fifteen past, good. Ne. Ungathi *(you mustn't say)* fifteen, quarter past, no. If uthi *(you say)* quarter, quarter, quarter past, good. One qha *(only)*. If uthi *(you say)* quarter, lahla bani? *(You throw away who?)* Fifteen. If uthi *(you say)* fifteen, lahla bani? *(You throw away who?)* Quarter! Nè? Ja. So, ngubani ke ngoku? *(Who is it now?)* | |
| | 47:13 | 1013. Lt, Lp: Quarter past, quarter past. | Lt: Half past, half past. | |
| 47:18 | | 1014. T: Who? Who is the short one? | T: Ngubani? Futshane, futshane ngubani? *(Who is it? The short one, short one? Who is it?)* | |
| | 47:20 | 1015. Lt: The short one. | | |
| 47:22 | | 1016. T: Again. | T: Again. |  |
| | 47:21 | 1017. Lt: Oh, quarter past three. | Lt: Past three. | |
| | 47:22 | 1018. Ls: Past three, past three. | | |
| 47:24 | | 1019. T: That's it! But it's not half, it's quarter, quarter, quarter. It's quarter past three. | T: Good! Good. Quarter not but not half. Le quarter, quarter, quarter, quarter, quarter. Nè it's quarter, quarter past three. | |
| | 47:30 | 1020. Lt, Ls, Lph, Lp: Quarter, quarter, quarter. | | |
| 47:40 | | 1021. T: Good. (Redraws the long hand on the clock pointing to four) now, what is the time? | T: Good. Now, ngubani ngoku? *(Who is it now?)* | |
| | 47:53 | 1022. Lz: Twenty… | | |
| 47:55 | | 1023. T: Don't tell, Don't tell. I want someone else. | | |
| | 47:57 | 1024. Lod: Four past three. | | The minute hand is re-positioned at 4 on the clock. |
| | 47:59 | 1025. Lph: Forty quarter past. | | |

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| | 48:03 | 1026. Lol: (Tries to get teacher's attention). | | |
| 48:03 | | 1027. T: No, you are saying too many things. Just say one thing | T: Hayi, zininzi izinto uzithethayo *(No, you are saying too many things)*. Just say one | |
| | 48:06 | 1028. Lt: Four past. | | |
| | 48:06 | 1029. Lph: Forty. | Lt: Four past. | |
| 48:07 | | 1030. T: Wait (to Lt). You answer (points at Lol). | | |
| | 48:11 | 1031. | | |
| | 48:11 | 1032. Lol: Four past three. | Lph: Forty five. | |
| 48:13 | | 1033. T: No. Not four. Remember, what does four stand for? | T: Uthi *(you say)* four, four. No. Remember, u-four umele bani? *(Four stands for who?)* | |
| | 48:19 | 1034. Lol: Four. | | |
| | 48:20 | 1035. Lz: Twenty, twenty, twenty. | | |
| 48:22 | | 1036. T: No (to Lol). Twenty, twenty. Yes. So what is the time? What is the time? Here (points at clock) What is the time? | T: Twenty, twenty, twenty. Ja. So ngubani ixesha? Ngubani ixesha? Apha, ngubani ixesha? *(What is the time? What is the time? Here, what is the time?)* | |
| | 48:28 | 1037. Lph: Twenty past quarter. | | |
| | 48:29 | 1038. Lol: Four. | | |
| | 48:29 | 1039. | Lt: Twenty past four. |  |
| 48:32 | | 1040. T: You are saying many things (to Lph). | | |
| | 48:33 | 1041. Lp: Twenty past three. | | |
| 48:36 | | 1042. T: Yes, twenty, twenty past three. | T: Ewe. Twenty, twenty past three. | |
| | 48:36 | 1043. Lt, Ls, Lp: Twenty past three. | Lt: Twenty past three. | |
| 48:40 | | 1044. T: Yes. (Erases long hand from the clock). Again, it goes. (Draws the long hand pointing to 5 on clock). Who is it? | T: Ja. Again, phinde *(again).* | |
| 48:54 | 48:53 | 1045. Lp: Twenty five. | | |
| 48:56 | 48:54 | 1046. Lt: Twenty five past five. | Lt: Twenty five past five. | |
| | 48:54 | 1047. Lph: Five. | | |
| | 48:55 | 1048. Lz: Twenty five past, twenty five past. | | Teacher re-positions minute hand at 5 on the clock. |
| | 48:56 | 1049. Ls: Five past, twenty five, twenty five, twenty five. | | |
| 48:58 | | 1050. T: (Looks at Lt). | | |
| | 48:57 | 1051. Lt: Twenty five past five, twenty five past five. | Lt: Twenty five past five. | |
| 49:00 | | 1052. Lp: Twenty five. | | |
| 49:01 | | 1053. T: Where is the short one standing? | T: Efutshane imephi? *(The short one is standing where?)* |  |
| 49:03 | | 1054. Lp: Three. | | |
| | 49:03 | 1055. Lt: The short one? | | |
| 49:05 | | 1056. T: Yes, who is it? | T: Ewe, ngubani? *(Yes, who is it?)* | |
| 49:06 | 49:05 | 1057. Lp: Twenty five past three. | | |
| 49:07 | | 1058. T: Yes, twenty five past three. (Redraws the long hand pointing to six on the clock) what does it say? | T: Ewe, twenty five past three. Ja. | |
| | 49:26 | 1059. Lp: Half… | | |
| | 49:26 | 1060. Lt: Three…Half, three, half three | Lt: Half, half three. | |
| | 49:27 | 1061. Ls: Three half thirty, thirty half past thirty, thirty | | The minute hand at 6 on the clock. |

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| | 49:31 | 1062. Lph: Fifty, fifty. | Lph: Fifty, fifty. | |
| | 49:35 | 1063. Lt: Half thirty. | Lt: Half, thirty. | |
| | 49:36 | 1064. Lph: O'clock. [*Teacher previously stated that 6=12 which is o'clock*]. | | |
| 49:36 | | 1065. T: No. | | |
| | 49:39 | 1066. Lod: O'clock. | | |
| | 49:39 | 1067. Lol: Three past thirty, three past thirty. | | |
| | 49:39 | 1068. Lan: Three past six, three past six. | | |
| | 49:39 | 1069. La: Three. | | |
| 49:44 | | 1070. T: You (points at La), who is it? | | |
| | 49:44 | 1071. Lan: (To La) Look at her. | | |
| | 49:45 | 1072. La: Half three. | Lt: Three. | |
| 49:50 | | 1073. T: There is just a small thing you leaving out. A small thing. | | |
| | 49:49 | 1074. Lan: Half past three. | | |
| | 49:49 | 1075. Lol: Half. | | |
| | 49:56 | 1076. La: Half… | | |
| 49:57 | | 1077. T: Half. Good. But who is the other thing? | | |
| | 50:00 | 1078. La: Three… | Lt: Three. | |
| 50:00 | | 1079. T: Good. Ok. But where? Where, where? (touches her torso) Where, where? | | |
| | 50:04 | 1080. Lan: Three past six. | | |
| | 50:04 | 1081. La: Three…five. | Lt: Three, half. | |
| | 50:07 | 1082. La: Half three. | | |
| | 50:11 | 1083. Lp: (Tries to get teacher's attention). | | |
| 50:12 | | 1084. T: I can't see where? Where? | | |
| 50:14 | 50:17 | 1085. Lan: Quarter thirty six, quarter thirty six. | | |
| | 50:17 | 1086. Lol: (Tries to get teacher's attention) three past thirty. | | |
| | 50:18 | 1087. Lod: To, to, to. | | |
| | 50:19 | 1088. La: Two. | | |
| | 50:20 | 1089. Lz: Three… | | |
| | 50:22 | 1090. | Lt: Three. | |
| | 50:24 | 1091. | Lph: Thirty, three. | |
| 50:23 | | 1092. Lp: You be quiet, you be quiet, you be quiet. | | |
| 50:26 | | 1093. T: (Points at La). That's good, yes. There's a small thing, a small thing you're forgetting. What is it? | | |
| | 50:35 | 1094. La: Three. | | |
| 50:37 | | 1095. T: (Speaks to a teacher who has entered the classroom). | | |
| | 50:36 | 1096. La: Fifty. | Lt: Three, thirty. | |
| | | 1097. Lol, Lt, Lp: (Try to get teacher's attention). | | |
| | 50:40 | 1098. Ls: Quarter three. | | |
| | 50:43 | 1099. La: Fifty, three, six. | | |
| | 50:46 | 1100. Lz: Three. | | |
| | 50:47 | 1101. Lod: Thirty. | | |
| | 50:49 | 1102. Lph: Three. | | |

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| | 50:51 | 1103. Lt: Half thirty. | | |
| 50:57 | 50:51 | 1104. (Teacher hands letters over). | | |
| | 50:52 | 1105. Lt: Three half thirty. | Lt: Half thirty. | |
| | 50:54 | 1106. Lp: Half three. | | |
| | 51:00 | 1107. Ls: Thirty, half, thirty, half | Lt: Three half thirty. | |
| 51:05 | 51:03 | 1108. T: (Points at La) there is a small, small thing you are forgetting. | T: …incinci, incinci into ayilibalayo, ntoni? *(There's something small, small, small that he is forgetting)* | |
| | 51:03 | 1109. Lph: Thirty three quarter. | Lph: Thirty three half. | |
| | 51:08 | 1110. Lz: Thirty half past, thirty half past. | | |
| | 51:08 | 1111. Lod: Quarter, thirty, thirty. | | |
| | 51:08 | 1112. Lan: Half, thirty. | | |
| 51:10 | 51:09 | 1113. T: You saying half, right. Three is right. But who? | T: Ewe ndithe le half right, three, right. Ngubani? *(Yes, I said this half is right. Who is it?)* | |
| | 51:16 | | Lt: Thirty three. | |
| | 51:16 | 1114. Lph: Three…three past. | Lph: Three. | |
| 51:17 | | 1115. T: I'm asking, where is it? | T: Ndiyabuza ndiphatha phi? *(I'm asking you where am I touching?)* | |
| | 51:19 | 1116. Lt: Half. | | |
| | 51:19 | 1117. Ls: Past, past, past. | | |
| | 51:19 | 1118. Lz: (Raises her hand). | | |
| 51:20 | | 1119. T: Is it here, is it here? (Pointing to her upper body) Where? | T: Apha? Apha? Phi? *(Here? Here? Where?)* | |
| | 51:21 | 1120. Lph, Lt: To, to, to. | | |
| | 51:21 | 1121. La: Five. | | |
| 51:22 | | 1122. T: Who is half, half, half? Where is it? Is it half to, half to? Where? | T: Xa wuthi half, half, half, phi? *(When you say half, where is it?)* Half to? Half to? | |
| | 51:25 | 1123. Lol: Thirty past. | | |
| | 51:26 | 1124. La: Six. | | |
| | 51:27 | 1125. Lz: (Raises her hand) Three. | | |
| | 51:28 | 1126. Lod: To, to, to, three. | | |
| | 51:29 | 1127. Lph: Quarter. | | |
| 51:28 | | 1128. Lp: (response not recorded) | | |
| 51:29 | | 1129. T: That's it! I said it's small. Half past, half past three, three | T: Ewe, ncinci *(it's small)* half past, half past three nè. | |
| | 51:35 | 1130. Lt: Half past three, half past three. | Lt: Half past three, half past three. | |
| 51:37 | | 1131. T: (Redraws the long hand pointing to 7 on the clock). | | |
| 51:47 | | 1132. T: (Points at clock) who is it now? | | |
| | 51:50 | 1133. Lol: Three. | | |
| 51:51 | 51:50 | 1134. Lt: Thirty. | Lt: Thirty five to three. | |
| | 51:51 | 1135. Lod: Past. | | |
| 51:52 | | 1136. T: Look. (Erases the short hand). Now, the short one goes a little bit. Do you hear? The short one goes a little bit (She draws the short hand closer to | |  The minute hand is positioned at 7 on the clock. |

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| | | 4). [*Teacher does not provide criteria as to why this occurs*]. | | |
| 52:22 | | 1137. T: (Points at clock). Who is the time? | |  |
| 52:27 | 52:26 | 1138. Lt: Thirty five to four. | Lt: Thirty five to four. | |
| | 52:28 | 1139. Ls: Five…four. | | |
| 52:30 | | 1140. T: Good. She said it is twenty five to four. [*Teacher changes the learner's response to the required response*]. | T: Good, good. Uthi *(you are saying)* twenty five to four. Good. | |
| 52:40 | 52:39 | 1141. Lp: Wonderful, wonderful | | |
| 52:41 | | 1142. T: (Redraws the long hand pointing to 8). | | |
| 52:57 | | 1143. T: Now who is it? | | |
| | 52:49 | 1144. Lod: Four to. | | |
| | 52:49 | 1145. | Lph: Four. | |
| | 52:50 | 1146. Lt: Forty. | Lt: Forty. | The hour hand moves closer to 4 on the clock. |
| 52:50 | | 1147. T: Don't tell (to Lt). I want another person to help me. Who is it? | | |
| | 52:54 | 1148. Lan: Forty… forty, forty, quarter. | | |
| | 52:57 | 1149. Lod: Four. | Lph: Four. |  |
| | 53:00 | 1150. | Lt: Four. | |
| | 53:01 | 1151. Lol: Four past thirty, thirty. | | |
| | 53:02 | 1152. Lan: Forty to four. | | |
| | 53:02 | 1153. | Lt: Four to thirty. | |
| | 53:03 | 1154. La: Thirty. | | |
| 53:02 | | 1155. T: No. | | |
| | 53:06 | 1156. Lan: Forty to four. | | |
| 53:06 | | 1157. T: (Shakes her head at learners' responses). | | |
| | 53:07 | 1158. La: Thirty past four. | | |
| 53:10 | | 1159. T: You (looks at La). Say that again. | | |
| | 53:10 | 1160. La: …Past four. | | The minute hand is positioned at 8. |
| 53:12 | | 1161. T: No. What is it? | | |
| | 53:12 | 1162. Lan: Forty to four. | | |
| | 53:14 | 1163. Lol: Forty. | | |
| | 53:15 | 1164. Lod: Four. | Lt: Twenty to four. | |
| 53:18 | | 1165. T: Don't tell (to Lt). | | |
| | 53:19 | 1166. Lod: Four. | | |
| | 53:20 | 1167. Lan: Forty past, forty to four, forty to… | | |
| 53:26 | | 1168. T: Say that again. | | |
| | 53:28 | 1169. Lan: Forty to four, forty to… | | |
| | 53:30 | 1170. La: Thirty. | | |
| 53:28 | | 1171. T: No (to Lan). Why, why are you saying Forty? There is another thing. | | |
| | 53:31 | 1172. La: Thirty…thirty to four. | | |
| 53:36 | | 1173. T: Again. | | |
| | 53:35 | 1174. La: Thirty to… | | |
| 53:38 | | 1175. T: No, no. | | |
| | 53:37 | 1176. Lol: Forty to four. Forty to four. | | |
| | 53:43 | 1177. Lan: …to eighty. | | |

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| 53:47 | | 1178. T: Remember, remember eight is the same as what? | | |
| | 53:51 | 1179. Lz: Twenty. | Lph: Twenty, twenty, twenty. | |
| 53:53 | | 1180. T: Twenty, twenty, twenty. Now, what is the time? You, go (to a learner). Now what is the time? Go out (to a learner at the door). | T: Twenty, twenty. Now ngubani time? *(What is the time?)* | |
| | 53:58 | 1181. | Lt: Hayibo, uyageza (No, you are showing off). | |
| 54:02 | | 1182. T: Now, who is the time? | | |
| 54:04 | 54:03 | 1183. Lt: Twenty to four. | Lt: Twenty to four. | |
| | 54:04 | 1184. Lz: Twenty, twenty, twenty to, twenty to four. | | |
| 54:07 | | 1185. T: Twenty to four. Yes. (Redraws the long hand pointing to 9). Who is it? Who is it? | |  |
| 54:23 | 54:22 | 1186. Lt: Ten to … | Lt: Ten to. | |
| 54:24 | | 1187. T: No. | | |
| 54:26 | 54:26 | 1188. Lp: Twenty five. | | |
| | 54:27 | 1189. Lt: Twenty five to four. | Lt: Twenty five to four. | |
| | 54:31 | 1190. Lph: Twenty to… | Lph: Twenty six… | |
| 54:31 | | 1191. T: No. Remember, remember nine is the same as who? | T: Remember, remember u-nine fana nabani? *(Nine is the same as who?)* | |
| | 54:37 | 1192. Lz: Ten. | Lz: Ten. | |
| 54:37 | | 1193. T: (Points at rights side of the clock). It's the same as who? Who? | T: Fana nabani? *(The same as who?)* | The minute hand is positioned at 9 on the clock. |
| 54:42 | 54:39 | 1194. Lt, Lz, Lph, Ls: Past, past, past. | Lt: Past. | |
| | 54:42 | 1195. Lp: Forty five, forty five. | | |
| | 54:42 | 1196. Lt: Half past. | Lt: Half past. | |
| | 54:43 | 1197. Lph: Four, four. | Lph: Four, four. | |
| 54:44 | | 1198. T: Quarter, quarter, quarter it's the same. | | |
| | 54:44 | 1199. Lt, Lp: Quarter, quarter. | | |
| 54:47 | | 1200. T: (Points at 9 on the clock). Who is it? | | |
| 54:49 | 54:50 | 1201. Lp: Quarter to. | Lp: …to. |  |
| | | 1202. T: (to Lp) say it again. | | |
| | 54:53 | 1203. Lp: Quarter to. | | |
| | 54:53 | 1204. Lt: Quarter to nine. | Lt: Half to nine. | |
| 54:57 | | 1205. T: Who? | T: Ngubani? *(Who is it?)* | |
| | 54:57 | 1206. Lt: Half, half. | Lt: Half, half | |
| 54:58 | | 1207. T: Who is the short one? | T: Futshane ngubani? *(Who is the short one?)* | |
| | 55:00 | 1208. Lt and Lp: Quarter to four. | Lt: Half to four. | |
| 55:02 | | 1209. T: Yes, quarter to four, quarter to four. Yes (Redraws the long hand pointing to 10). Who is this? We are doing the last one now. It's the last one. Who is this? | T: Yes. Quarter to four, ne quarter to four. Ja. Ngubani? Senza eyokuqgibela ngoku. Senza eyokuqgibila ngoku. *(Who is it? We are doing the last one now. We are doing the last one now.)* | The minute hand points at 10. The teacher's diagram does not clearly show the two hands of a clock. |

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| 55:22 | 55:22 | 1210. Lt: Ten | Lt: Ten… hayi *(no).* | |
| | 55:26 | 1211. Lan: Ten, ten, ten. | | |
| 55:24 | | 1212. T: Don't tell, wait a bit. I want to ask someone else. You are right (to Lp). You are also right (to Lt). What do you say? (To Ls). | |  |
| | 55:32 | 1213. Ls: Ten to four. | | |
| | 55:34 | 1214. T: Again. | | |
| 55:35 | 55:36 | 1215. Ls: Ten to four. | | |
| 55:36 | 55:38 | 1216. T: Good! (Applauds. Redraws the long hand pointing to 11). Who is that? | T: Good. | |
| 55:39 | 55:53 | 1217. Ls, Lt: It's her turn (pointing to Lph). | | |
| | 55:56 | 1218. T: You (To Lph). | | |
| 55:57 | 56:00 | 1219. Lph: Five four to. | Lph: Five four. | |
| 56:03 | | 1220. T: No. | | |
| | 56:03 | 1221. Lph: Five, quarter, four. | Lph: Five. | |
| 56:06 | | 1222. T: No. | | |
| | 56:07 | 1223. Lph: Forty. | Lph: Forty. | The teacher was re-positioning the minute hand but has now drawn the minute hand shorter than the hour hand. |
| 56:10 | | 1224. T: No. | | |
| | 56:14 | 1225. Lph: Eleven… | | |
| 56:17 | | 1226. T: You are right. Yes. There is a five and there is a "to" and there is a four. Now, make it nicely. | T: Uright. Ewe, ufive ukhona, ewe to ukhona, ewe ufour ukhona. Qha, now use it kakuhle. *(You are right. Yes, five is there, yes to is there, yes four is there. Only now use it properly)* | |
| | 56:26 | 1227. Lph: Fifty to… three. | Lph: Fifty. | |
| 56:28 | | 1228. T: No. | | |
| | 56:34 | 1229. Lph: Ten to past. | | |
| 56:33 | | 1230. T: No. | | |
| | 56:37 | 1231. Lph: Five quarter. | | |
| 56:37 | | 1232. T: No. You are right. There is a five. Yes, there is a five. Who is it? | T: U right, uright ufive ukhona. Ewe ufive ukhona. Ngubani? *(You are right, you are right five is there. Yes, five is there. Who is it?)* | |
| | 56:43 | 1233. Lph: Quarter to five. | | |
| 56:46 | | 1234. T: No. You (points at Lod). Help. | | |
| | 56:55 | 1235. Lod: Eleven… | | |
| 57:05 | | 1236. (Lesson is interrupted by video crew). | | |
| 57:30 | | 1237. T: Where is it? | | |
| | 57:25 | 1238. La: Quarter to five. | | |
| | 57:27 | 1239. Lz: Five, five, quarter to four. | Lz: Five, five. | |
| 57:32 | | 1240. T: No. Where is it? | | |
| 57:33 | | 1241. Lp: Fifty five to four. | | |
| 57:36 | | 1242. T: No, I don't want fifty five. | | |
| 57:38 | 57:38 | 1243. Lp: Fifty. | | |
| 57:40 | | 1244. T: No. Who is it? | | |

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| | 57:40 | 1245. Lt: Five to. | Lt: Five to… | |
| | 57:42 | 1246. Lph: Quarter to. | | |
| 57:44 | | 1247. T: (Points at Lt). | | |
| | 57:45 | 1248. | Lt: Five to four. |  The teacher's drawing does not clearly show the difference between the short and long hands. |
| 57:47 | | 1249. T: That's it. Five to four. (Redraws the long hand pointing to 12) | T: Five to four. | |
| 57:54 | | 1250. Lp: it's fifty five. Look (pointing to clock on left side board). | | |
| 58:04 | | 1251. T: The last one. Who will help me? Help, help, help. Who, who, now? | T: Eyokuqgibela. Ngubani ozondihelp? Bani? Bani, bani? *(This is the last one. Who is going to help? Who, who?)* | |
| | 58:10 | 1252. Lz: Lol, Lod: O'clock, o'clock. | | |
| | 58:13 | 1253. Lph: O'clock. | | |
| | 58:15 | 1254. Lt, Ls: Four o'clock, o'clock. | | |
| | 58:17 | 1255. Lp: …to four. | Lt: Four. | |
| 58:19 | | 1256. T: Who is it? Who is it? Who is it? | | |
| | 58:19 | 1257. Lt: Twelve o'clock. Four. | Lt: Twelve, four. | |
| | 58:21 | 1258. Ls: O'clock two. | | |
| | 58:24 | 1259. Lph: Fifteen o'clock. | | |
| 58:26 | | 1260. T: No. | | |
| | 58:28 | 1261. Lol: O'clock. | | |
| 58:28 | | 1262. T: Who o' clock? (Points at clock on board). Who o'clock? | T: Four o'clock, four o'clock. [*Teacher produces required response*]. | |
| | 58:31 | 1263. Lph: Half, half, fifteen. | | |
| | 58:31 | 1264. Lz: Five. | | |
| 58:36 | 58:31 | 1265. Lt: Four. | | |
| 58:36 | | 1266. T: Four o'clock, four o'clock. | | |
| | 58:37 | 1267. Lz, Lph, Lod: Four o'clock, four o'clock. | | |
| 58:42 | | 1268. T: Ok we finish now. Thank you, thank you very much. I will give you copies of the work on "Time" tomorrow. We finish. Thank you. (End of lesson) | | |

**Comments:**

At the end of the lesson, the learners are still not clear about the rules to describe the time. They seem to be trying to guess the rules. The rules for describing the time have not been made explicit.

# Appendix J: Transcript and Analysis of a Grade Six Lesson Presented on Fractions

Symbols: T: Teacher's signing or speech
Ll, Lp, Ln, Ls, Lv: Individual learners' signing
T-DVD: Time taken from the DVD which focussed on the teacher
L-DVD: Time taken from the DVD which focussed on the learners

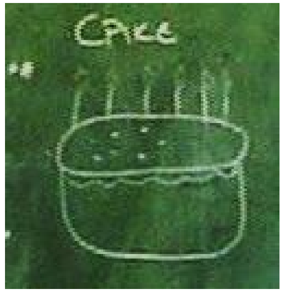
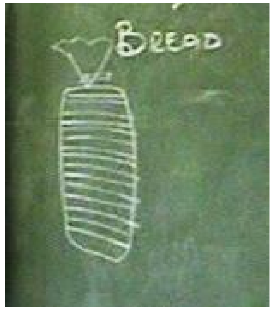
## Evaluative Event 1: Representing Fractions

### Evaluative Event 1.1: Dividing a loaf of bread into parts

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 00:04 | | 1. T: (To Ll) please go around to the next class to fetch some white chalk. | | |
| 00:10 | 00:08 | 2. Ll: (Gets up to fetch chalk). | | |
| 00:30 | | 3. T: (Wipes the chalk board clean. Picks up a box from the learners' desk. Writes the date and "Maths" on the board). | | |
| | 00:13 | 4. (Learners chat amongst themselves). | | |
| | 01:00 | 5. Ll: (Returns with chalk). | | |
| 01:48 | | 6. T: (Tries to get the learners' attention). Good morning, good morning. How are you? | | |
| | 01:30 | 7. Lp, Lv, Ln: Good morning. | | |
| | 01:35 | 8. Lp, Ln, Lv: I'm fine. | | |
| 01:58 | | 9. T: Do you know respect? Please respect. Respect please.[33] | | |
| | 01:41 | 10. Ll: What's this? (Imitates incorrect sign). It is respect (corrects teacher's sign). | | |
| | 01:43 | 11. (Learners show correct sign for "respect"). | | |
| 02:04 | | 12. T: Respect. Thank you. Do you remember the work we did a while ago? What was it about? | | |
| | 01:50 | 13. Lp: (Recalls previous lesson) different pieces, plus, etc. | | |
| 02:24 | | 14. Ls: Adding. | | |
| 02:33 | | 15. T: Do you all remember? Remember? | | |
| | 02:10 | 16. Lp: I remember. | | |
| | 02:11 | 17. Ll: A and B passed. | | |
| | 02:12 | 18. Ln: I remember. | | |
| 02:37 | | 19. T: Ok. Now today… Do you know bread? A loaf? | | |
| | 02:23 | 20. Lp: Yes, I know. A loaf of bread. | | |
| | 02:25 | 21. Lp, Ll, Lv: Yes, a loaf. | | |
| 02:52 | | 22. T: Who can draw it on the board? Draw bread. Draw it? Draw it? | | |

[33] The teacher signs "respect" incorrectly and is shown the correct sign by a learner

| | | | | |
|---|---|---|---|---|
| | 02:34 | 23. Lv, Ls: Twenty, twenty. | | |
| | 02:36 | 24. Lp: How many slices? Twenty three—in a brown bread and white bread. | | |
| 03:02 | | 25. T: A loaf of white and brown. Which colour? White? Who can draw it? Come draw it please. | | |
| | 02:53 | 26. Ll: A loaf of bread with slices. | | |
| | 02:54 | 27. Ln and Ls: (Draw in the air with their fingers). | | |
| 03:11 | | 28. T: Who will draw? Who wants to draw on the board? | | |
| | 03:11 | 29. Ln: A loaf of white has twenty one. | | |
| | 03:12 | 30. (Learners discuss the number of slices in a loaf). | | |
| | 03:26 | 31. Ll: (To Lp) Who can draw the bread? | | |
| 03:21 | | 32. T: Where? Where? | | |
| 03:23 | | 33. Ls: (Draws in the air with his fingers). | | |
| 03:42 | | 34. T: Look at me. Who will draw it? Who wants to draw on the board? | | |
| | 03:31 | 35. Ll: (To Lp) go and draw it. | | |
| 03:48 | | 36. T: Who wants to? | | |
| 03:58 | | 37. T: Try, try (to Lp) | |  |
| 04:03 | 03:35 | 38. Lp: (Goes to the board and draws). | | |
| | 03:36 | 39. (Some learners draw with their fingers on their desks). | | |
| 04:30 | 04:06 | 40. T: Ok. What did you draw? | | |
| 04:33 | | 41. Lp: I tried. It's a loaf of bread with slices. | | |
| | 04:13 | 42. T: Is it brown or white bread? | | |
| 04:38 | | 43. Lp: It's brown. | | |
| | 04:16 | 44. T: Brown. Ok. Thank you. | | |
| 04:44 | | 45. Lp: (Returns to her desk). | | |
| | 04:22 | 46. (Learners talk amongst themselves). | | |
| 04:51 | 04:26 | 47. T: All of you. It's a loaf. | | |
| | 04:35 | 48. Lp, Ln: It's a loaf of bread | | |
| | 04:39 | 49. Ll: I know how to make it half. | | |
| 04:59 | | 50. T: (Gets chalk). | | A loaf of bread drawn by a learner. |
| | 04:48 | 51. (Learners talk amongst themselves). | | |
| 05:21 | | 52. T: Do you know cake? Do you know what cake is? | | |
| | 05:07 | 53. Lp: (Raises her hand). | | |
| | 05:07 | 54. Ls: cake, cake, cake. | | |
| | 05:08 | 55. Ln: (Raises her hand). | | |
| 05:28 | | 56. T: Come and draw it on the board (to Ls). | | |
| 05:29 | 05:10 | 57. Ls: Ask her (Lp), I don't know how. | | |
| | 05:12 | 58. Lp: (Still has her hand raised). | | |
| 05:33 | | 59. T: I want someone else. I want someone else. | | |
| | 05:13 | 60. (Some learners are drawing with their fingers on their desks and chatting). | | |
| 05:40 | | 61. Lv: (Raises her hand but puts it down again). | | |
| 05:41 | | 62. T: I want someone else. How do you draw a cake? | | |
| 05:47 | 05:27 | 63. (Learners continue to draw in the air or on their desks with their fingers). | | |
| 05:56 | 05:38 | 64. T: You. (Points at Ln) Come draw it on the board. | | |

| | | | | |
|---|---|---|---|---|
| 05:58 | 05:39 | 65. Ln: (Continues to draw in the air). | | |
| 06:01 | 05:43 | 66. T: Go up. | | |
| 06:05 | 05:45 | 67. Lp: Do you know how? Draw a big birthday cake with candles. | | |
| 06:09 | 05:56 | 68. Ln: (Goes to the board and draws a cake. She returns to her desk). | | |
| 07:06 | | 69. T: Okay. What is this? (Points at the bread). | | |
| 07:13 | 06:52 | 70. Ls, Ll: Bread. | |   |
| 07:13 | | 71. T: It's bread. (Writes 'bread' on the board. Points at the cake). What is that? | | |
| | 07:00 | 72. Lp, Ls, Ln: Cake. | | |
| 07:22 | | 73. T: (Writes 'cake' on the board). | | |
| | 07:02 | 74. Lp, Ln: (Spell C-A-K-E with fingers). | | |
| 07:28 | | 75. T: All of you… When you have to choose, which one will you choose? | | |
| | 07:15 | 76. Ll: I'll have cake. | | |
| 07:39 | | 77. T: Cake, why? | | |
| | 07:19 | 78. Lp: Cake tastes good! Birthday cake is delicious! | | |
| | 07:20 | 79. Ll: Because we celebrated my sister's birthday. | | |
| | 07:24 | 80. Lp: It makes me happy. | | |
| 07:47 | | 81. T: Ok, now we change (Points at the bread). Is it big…? | | A cake drawn by a learner. |
| | 07:29 | 82. Lp: Because you can eat bread. | | |
| | 07:29 | 83. Ll: You eat bread in the morning. | |   |
| | 07:33 | 84. Lv, Lp, Ll, Ln: A big loaf of bread. | | |
| 07:54 | | 85. T: … or small? Big or small? | | |
| 07:55 | | 86. Ln: It's big, big. | | |
| 07:58 | | 87. T: And when it's a small loaf…? | | |
| | 07:37 | 88. Lp: A half loaf | | |
| | 07:38 | 89. Ll: A half loaf the two of us can eat (points at Ln). If it's a big loaf, all of us can eat. | | |
| | 07:43 | 90. Ln, Lp, Ls: All of us can eat from loaf of bread. | | |
| 08:08 | | 91. T: Wait. Look. (Points at a slice of the bread drawn on the board). It's a slice. | | |
| | 07:52 | 92. Ll, Ln: It's a slice. | | |
| 08:17 | | 93. T: How many are there? | | |
| | 07:56 | 94. Ls: Two. | | Teacher has labelled the drawings as "bread" and "cake". |
| 08:18 | | 95. T: Two? | | |
| | 07:55 | 96. Lp: One. | | |
| | 07:56 | 97. Ln: Twenty one, twenty one, twenty one. | | |
| | 07:56 | 98. Ll: Twenty three. | | |
| 08:22 | | 99. T: Twenty one, twenty two? How many? | | |
| | 08:00 | 100. Ll: Twenty three. | | |
| | 08:02 | 101. (A learner is at the door). | | 22 |
| 08:26 | | 102. T: Wait (to someone at the door) Twenty three? Twenty four? | | |
| | 08:05 | 103. Lp: One. | | |
| | 08:05 | 104. Ln: Twenty one. | | |
| | 08:05 | 105. Ll: Twenty three. | | |
| 08:33 | 08:11 | 106. Ls: Twenty, twenty, twenty. | | |
| 08:37 | | 107. T: (Writes '22' on the board). Twenty two. Are there twenty two in a loaf? | | |

| | | | | |
|---|---|---|---|---|
| | 08:18 | 108.Ln: Twenty two? | | |
| | 08:18 | 109.Ll: Is it true? | | |
| | 08:20 | 110.Lv: Yes it is. I've counted. | | |
| 08:46 | | 111.T: (Counts the lines/ slices). There are twenty two. Are there twenty two? Twenty two, twenty three. Which one is right? | | 11 |
| | 08:24 | 112.Ln: I counted twenty one. | | |
| | 08:25 | 113.Ll: I say it's twenty three, twenty three, twenty three. | | |
| 08:58 | 08:36 | 114.Ln: Twenty four. | |  |
| 08:59 | | 115.T: Let's say twenty two (points at 22 on the board). We say it is twenty two, we say twenty two. All of you look (pay attention). What do you say? | | |
| | 08:37 | 116.Lp: It's a big loaf of bread. It's soft and nice to eat. | | |
| | 08:49 | 117.Ls: Twenty four. | | |
| 09:13 | | 118.T: What do you say when it's a small loaf? | | |
| 09:14 | 08:52 | 119.Ls: A small loaf? Eleven, eleven. | | |
| 09:15 | 08:52 | 120.Ll: Ten. | | |
| 09:19 | | 121.T: A small loaf? | | |
| 09:19 | 08:56 | 122.Ln, Ls: Eleven. | | Teacher has written 22 and 11 next to the loaf of bread. |
| | 08:56 | 123.Ll: Ten. | | |
| | 08:59 | | Lp: Eleven. | |
| 09:21 | | 124.T: Eleven, eleven, eleven. | | |
| 09:25 | 09:00 | 125.Ln: Twelve, twelve, twelve. | | |
| | 09:00 | 126.Ll: Ten, ten, ten. | | |
| 09:25 | 09:02 | 127.Ls: Ten in a half loaf. | | |
| | 09:03 | 128.Ll: You are just copying me. It's ten. | | |
| | 09:07 | 129.Lp: It's ten. | | |
| 09:28 | | 130.T: (Writes 11 on the board) eleven, eleven, eleven. | | |
| 09:31 | 09:07 | 131.Ln: It's twelve (to Ls). | | |
| 09:32 | 09:08 | 132.Ls: It's ten. | | |
| 09:36 | | 133.T: (Erases 11). Who[34] is the half of twenty two? | | |
| | 09:15 | 134.Ll: Ten. | | |
| 09:41 | 09:16 | 135.Ln: A small loaf. | | |
| 09:42 | | 136.T: What is the half of twenty two? | | |
| 09:44 | 09:20 | 137.Ln: Half is twenty one. | | |
| | 09:20 | 138.Ll: There are twenty in a loaf, twenty in a loaf. | | |
| 09:49 | 09:25 | 139.Ln: A loaf of bread is one, two[35]. | | |
| 09:50 | 09:26 | 140.Ls: Twenty, twenty, twenty. | | |
| | 09:26 | 141.Lv: Ten. | | |
| | 09:28 | 142.Ll: Twenty two, twenty two. | | |
| | 09:23 | 143.Lp: Ten and ten, and two… Eleven. Listen, it's eleven, eleven. | | |
| 09:54 | | 144.T: It's eleven, eleven, eleven (Writes '11' on the board). | | |



[34] Teacher uses sign for "who" when referring to numbers or objects
[35] Learner seems to be reversing the sign for twenty one and signs "one, two".

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|---|---|---|---|---|
| | 09:37 | 145.Ln: You said it's twelve. | | |
| | 09:38 | 146.Lp: You must divide it, see, you divide it. | | |
| | 09:38 | 147.Ll: (Counts on her fingers). Ten? | | |
| | 09:42 | 148.Lp: Ten. | | |
| | 09:43 | 149.Ll: You also do it. | | |
| | 09:43 | 150.Ln: (Holds up ten fingers) | | |
| | 09:46 | 151.Lv: Ten | | |
| | 09:52 | 152.Lp: Then two… (Looks at teacher who is trying to get their attention). | | |

**Comments**:

- The teacher's resources are representations of objects such as bread and cake.
- The bread is divided into slices. The number of slices is counted.
- The teacher uses "small loaf" to implicitly refer to half a loaf of bread.

**Criteria for dividing objects:**

- An object such as bread was segmented into parts which were counted.
- A loaf consisted of twenty two slices.
- It was implicit that a "small loaf" represented half of a "loaf" as it contained eleven slices.

### Evaluative Event 1.2: A loaf of bread $\frac{8}{16}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 10:04 | | 153. T: Look. (Tries to get the learners' attention. Points at each slice of bread drawn on the board). How many are there? | | |
| | 10:02 | 154.(Some learners count with the teacher). | | |
| | 10:08 | 155.Lp: Eighteen, eighteen. | | |
| 10:24 | | 156.T: (Points at Lp). How many are there? | | |
| | 10:10 | 157.Lp: There. | | |
| 10:33 | | 158.T: What? | | |
| | 10:11 | 159.Lp: (Does not respond). | | |
| 10:35 | 10:12 | 160.T: (Points at each slice and learners start counting). | | |
| 10:48 | 10:22 | 161.Ln: Sixteen, sixteen. | | |
| | 10:23 | 162.Ll, Lp: Sixteen, sixteen. | | |
| 10:49 | | 163.T: Sixteen, sixteen. So, half of that is what? | | |
| 10:52 | 10:27 | 164.Ln: The half is…fifteen, fifteen. | | |
| | 10:28 | 165.Ll: Ten, ten, no, nine, nine. | | |
| | 10:33 | 166.Lp: Thirteen, thirteen. Must you divide it? | | |
| 11:00 | | 167.T: Thirteen? What is the half of sixteen? | | |

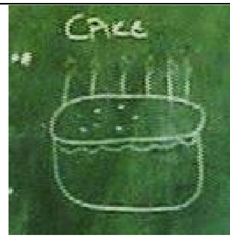
| | | | | |
|---|---|---|---|---|
| | 10:36 | 168.Ll: Nine, nine, nine. | |  |
| 11:02 | 10:37 | 169.Ls: Twenty, twenty. | | |
| | 10:38 | 170.Lp: Sixteen…? Twelve. | Lp: Twelve | |
| | 10:41 | 171.Ll: Eight, eight. | | |
| 11:06 | 10:41 | 172.Ln: The half is fourteen. | | |
| 11:08 | | 173.T: There it is. (Erases 22 and 11 from the board). Look. (Points at each slice of bread from the bottom and stops in the middle). | | |
| | 10:53 | 174.(Some learners count while he points). | | |
| | 10:57 | 175.Lp: It's eight. | | |
| | 10:58 | 176.Ll: Eight. Why sixteen? | | |
| 11:25 | | 177.T: (Shades in bottom section of bread in red). | | Teacher shades bottom section of the bread. |
| | 11:07 | 178.Ln: He's dividing it. | | |
| | 11:12 | 179.Lp: It's six and six for each part. | | |
| | 11:16 | 180.Ln: But it's a big loaf of bread. | | |
| | 11:17 | 181.Lp: But he's dividing it in two with six slices in each half. | | |
| | 11:19 | 182.Ll: It's ten, eleven or twelve. | | |
| 11:49 | | 183.T: How many is the coloured part? (Points at shaded area of bread). | | |
| | 11:26 | 184.Ll: Eight. | | |
| 11:54 | | 185.T: Eight. How many are here? (Points at unshaded area). | | |
| | 11:30 | 186.Lp: Six. | | |
| | 11:30 | 187.Lv: Eight. | | = |
| 11:57 | 11:30 | 188.Ls: Seven. | | |
| 11:59 | 11:33 | 189.Ln: Seven. | | |
| 12:00 | | 190.T: (Looks at Ln). Wait. | | 8 |
| | 11:39 | 191.Lp: Eight. | | |
| | 11:39 | 192.Ll: Nine. | | $\frac{8}{\phantom{16}}$ |
| 12:07 | | 193.T: (Writes = next to the bread). | | |
| | 11:40 | 194.Lp: Look it is eight. | | |
| 12:10 | | 195.T: (Points at unshaded area of bread). | | $\frac{8}{16}$ |
| 12:11 | 11:44 | 196.Ln: Eight. | | |
| 12:12 | | 197.T: (Writes 8). The part with no colour has how many? Eight. | | |
| 12:16 | 11:49 | 198.Ln: The part with no colour. | | |
| 12:18 | 11:50 | 199.Ls: Nothing. | | |
| 12:19 | | 200.T: (Draws a line below 8). How many slices in the whole loaf? | | |
| 12:24 | 11:56 | 201.Ln: Twenty one, twenty one, twenty one. | | |
| | 11:56 | 202.Lp, Lv, Ll: Sixteen, sixteen. | | |
| 12:24 | 11:57 | 203.Ls: Twenty two, twenty two. | | |
| 12:24 | | 204.T: Sixteen, sixteen (Writes 16). | | |
| 12:27 | 11:58 | 205.Ln: I'm mad, it's sixteen. | | $\frac{8}{\phantom{16}}$ |
| 12:30 | | 206.T: Do you understand? Understand? Understand? | | |
| | 12:07 | 207.Lp: Yes, I understand. | | |
| | 12:08 | 208.Lv: Ok. | | |
| 12:37 | | 209.T: Again. (Points at the unshaded section then points at 8). There are eight in the part | | $\frac{8}{16}$ |

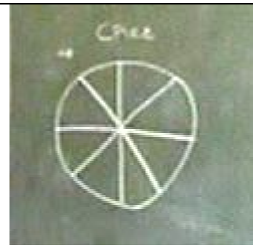
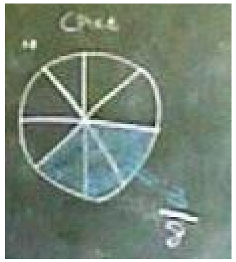
| | | | | |
|---|---|---|---|---|
| | | with no colour. | | |
| | 12:13 | 210.Lp, Lv: Nothing. | | |
| 12:43 | | 211.T: Altogether there are sixteen. | | |
| | 12:14 | 212.Lp, Lv: Altogether. | | |
| | 12:16 | 213.Ln: Those with colour are sixteen. | | |
| 12:46 | | 214.T: Altogether there are sixteen. Ok. How many are coloured in? | | |
| 12:52 | 12:25 | 215.Ln: Seventeen. | | |
| | 12:25 | 216.Ll, Lp: Eight. | | |
| 12:54 | | 217.T: Eight (Points at shaded area. Writes 8/). How many are there altogether? | | |
| | 12:34 | 218.Lv, Lp, Ll: Sixteen. | | |
| 13:03 | | 219.T: Sixteen. | | |
| | 12:35 | 220.Lp, Lv: Yes. | | |
| 13:04 | | 221.T: (Writes 16 below 8). Look, look. Do you understand? Do you understand this? (Points at work on chalkboard). | | |
| | 12:47 | 222.Lp: Because I don't understand him (To Ll). I understand. I know it (To T). | | |

**<u>Criteria for fractional representation</u>:**

- Divide an object into parts
- Shade in a number of parts
- Count the number of shaded parts. Write as the numerator.
- Count the total number of parts in the object. Write as the denominator.

## Evaluative Event 1.3: Cake: $\frac{3}{8}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 13:25 | | 223.T: (Points at drawing of cake) what is this? What is this? | |  |
| | 12:55 | 224.Lp: We can slice it into parts. | | |
| 13:30 | 13:02 | 225.Ls: Cake, cake, cake. | | |
| | 13:02 | 226.Lv: Fifteen altogether. | | |
| | 13:03 | 227.Ln: Ten. | | |
| | 13:06 | 228.Ll: Five. | | |
| 13:32 | | 229.T: It's cake, cake. This is cake. Wait. Cake, cake. (Erases the cake. Draws a circle). | | |
| | 13:10 | 230.(Learners chat while he draws). | | |
| 14:02 | | 231.T: It's a cake. Do you see the cake? | | Teacher initially refers to this drawing of cake. |
| | 13:34 | 232.Lp: That's wrong. There should be eight. | | |
| 14:08 | | 233.T: (Divides cake into four parts). | | |
| | 13:40 | 234.Ln: He's dividing it. | | |
| 14:15 | | 235.T: How many altogether? | | |

| | | | | |
|---|---|---|---|---|
| | 13:45 | 236.Lp, Ll, Ln: Four. | Lp: Four |  |
| 14:17 | | 237.T: (Divides cake into six parts). How many? | | |
| | 13:50 | 238.Lp, Ln: Six. | | |
| 14:22 | | 239.T: (Divides cake into eight parts). | | |
| 14:25 | 13:54 | 240.Ls: Seven (looks at the others), eight. | | |
| | 13:54 | 241.Ln, Lp: Eight. | | |
| 14:27 | | 242.T: How many? | | |
| | 13:58 | 243.Ln, Lv, Lp: Eight. | | |
| | 13:59 | 244.Ll: Altogether there are eight. | | |
| 14:30 | | 245.T: Are there eight altogether? | | Teacher replaces previous drawing of cake with this one. |
| | 14:01 | 246.Lp, Lv: Yes. | | |
| 14:33 | | 247.T: Wait. | | |
| | 14:01 | 248.Ln: (Counts the number of parts) | Ln: Four | |
| 14:36 | | 249.T: I want one, I want one. Colour in three over there. | | |
| | 14:13 | 250.Ll: Three? | | |
| | 14:14 | 251.Lv: Four. | | |
| | 14:14 | 252.Lp: Two. | | |
| 14:43 | | 253.T: Colour three. | | |
| | 14:16 | 254.(Lv gets up and goes to the chalkboard). | | |
| 14:50 | | 255.T: Three. | | |
| 14:55 | | 256.Lv: (Shades three parts in blue). | | |
| 15:10 | | 257.T: Ok, ok. How many did she colour in? | | |
| 15:13 | 14:41 | 258.Ln: Four, three. | | |
| | 14:41 | 259.Lp: Five, three. | | |
| | 14:43 | 260.Lv: Three. | | |
| | 14:43 | 261.Ll: (To Lp) did you already say five? | | |
| | 14:46 | 262.Lp: Yes. | | |
| 15:13 | | 263.T: How many have colour? | | |
| | 14:48 | 264.Ln, Ll, Lv: Three. | | |
| | 14:47 | 265.Ls: Two. | |  |
| 15:19 | | 266.T: (Looks at Ls) how many? | | |
| 15:20 | 14:48 | 267.Ls: Two. | | |
| 15:20 | 14:48 | 268.Ln: Four, three. | | |
| 15:21 | | 269.T: How many have colour? | | |
| 15:22 | 14:51 | 270.Ls: There are …it's there. | | |
| 15:22 | 14:51 | 271.Ln: There are three. | | |
| 15:26 | | 272.T: Look here (Points at drawing). | | |
| 15:26 | 14:54 | 273.Ln, Lv: (Tell Ls) there are three. | | |
| 15:27 | 14:54 | 274.Ls: There are three. | | Teacher uses the cake to represent a fraction $\frac{3}{8}$ |
| 15:28 | | 275.T: Look here. Three? What three? | | |
| 15:30 | 14:58 | 276.Ls: There is one, there is one. | | |
| | 14:59 | 277.Lp: With colours. | | |
| 15:32 | | 278.T: What is there? | | |

| | | | | |
|---|---|---|---|---|
| | 15:00 | 279.Ls: There's one in the colour red. | | |
| | 15:04 | 280.Lp: There are three in colour (To Ls). | | |
| 15:36 | | 281.T: (Writes = 3/) how many altogether? | | |
| | 15:08 | 282.Ll, Lv: Eight. | | |
| 15:42 | 15:10 | 283.Ln: Five. | | |
| | 15:11 | 284.Lp: Five. | | |
| 15:44 | | 285.T: (Writes 8). Do you understand, understand? Do you understand? Do you know it? | | |
| | 15:19 | 286.(Some learners nod). | | |
| | 15:20 | 287.Lp: Yes, I know it. You should write pizza there. It's good. | | |
| 15:58 | | 288.T: What? | | |
| | 15:25 | 289.Lp: P-I-Z-Z-A. It's good. Write it there. | | |
| 16:00 | | 290.T: Say that again. | | |
| | 15:29 | 291.Lp: He doesn't understand. P-I-Z-Z-A. You can slice it up. | | |
| 16:03 | | 292.T: P-I…Ok, Ok. It's the same, the same. Now look here. | | |
| | 15:40 | 293.(Learners chat). | | |

**Criteria for fractional representation:**

- Divide an object into a number of parts.
- Shade in a specified number of parts in a specified colour.
- Write the cardinality as the numerator within the spatial frame.
- Count the number of parts in the whole object.
- Write this number as the denominator in the spatial frame.

## Evaluative Event 2: Adding two fractions with a common denominator

### Evaluative Event 2.1: Example One: $\frac{3}{8} + \frac{5}{8} = \frac{8}{8}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 16:21 | | 294.T: (Writes +). How many have no…? | | + |
| 16:26 | 15:54 | 295.Ls: Ten. | | |
| 16:27 | 15:55 | 296.Ln: Eleven. | | |
| 16:27 | | 297.T: How many have no colour? | | |
| 16:30 | 15:56 | 298.Ls: No colours… five. | | |
| | 15:58 | 299.Lp: Lv: Five. | | |
| | 15:58 | 300.Ln: Four. | | |
| | 16:00 | 301.Ll: Eight. | | |
| 16:37 | | 302.T: How many have no colour (points at cake drawn on the board)? How many with no colour? | | |
| 16:41 | 16:06 | 303.Ls: Six. | | |

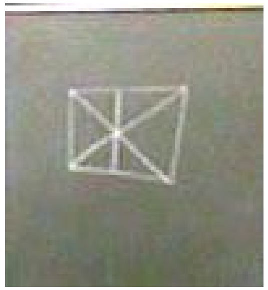
| | | | | |
|---|---|---|---|---|
| | 16:07 | 304.Ll: Five. | | $\frac{5}{\ }$ |
| | 16:07 | 305.Lp: Five. | | |
| | 16:08 | 306.Lv: Three. | | |
| | 16:07 | 307.Ln: (Counts on her fingers) eight. | | $\frac{5}{8}$ |
| 16:44 | | 308.T: (Writes 5/). How many altogether? | | |
| | 16:14 | 309.Ll: Eight. | | |
| 16:50 | | 310.T: (Writes 8). Look here, look here. | | |
| | 16:20 | 311.(Ll and Lp are chatting). | | |
| 16:55 | | 312.T: (Points at the 8 of 3/8). You, sit. Sit properly (to Lv). (Points at 8 of 3/8). | | |
| | 16:29 | 313.Lp: (To Lv) sit properly. You can't learn if you're slouching. | | |
| 17:05 | | 314.T: (Points at 8 of 3/8). | | |
| | 16:30 | 315.Lv: (Sits upright) eight. | | |
| 17:10 | | 316.T: (Points at 8 of 5/8). | | |
| | 16:37 | 317.Lv: It's eight. | | |
| | 16:38 | 318.Lp: Yes, eight. | | |
| 17:11 | | 319.T: They are the same. (Points at both denominators). They are the same. | | |
| | 16:40 | 320.Lp: They are the same. | | |
| 17:18 | | 321.T: (Points at numerators). They are different. | | |
| | 16:43 | 322.Lp: They are different, they are different. | | |
| | 16:45 | 323.Lv, Ll, Ln: They are different. | | |
| 17:23 | | 324.T: Do you understand? | | |
| | 16:48 | 325.Lp: Yes. | | $\frac{3}{8}+\frac{5}{8}=$ |
| 17:24 | | 326.T: (Points at both denominators). They are the same. | | |
| | 16:50 | 327.Lp: They are the same. Do you understand? (To Ll) | | |
| | 16:54 | 328.Ll: I don't know. | | |
| 17:27 | | 329.T:  Look. (Points at numerators) they are different. | | |
| | 16:55 | 330.Lv: They are different. | | |
| | 16:56 | 331.Ll: They are different. | | $\frac{3}{8}+\frac{5}{8}=\frac{3+5}{8}$ |
| 17:31 | | 332.T: When these (points at denominators) are the same… (Writes =). They become one. | | |
| | 17:08 | 333.Ln: Twelve, twelve. | | |
| 17:46 | 17:11 | 334.Ls: Three. | | |
| | 17:12 | 335.Lp: Eight is right. It's the same. There is eight on top. | | |
| 17:47 | | 336.T: (Points at denominators). They are the same so take one. (Points at denominator and nods. Then points at numerators). | | $\frac{3}{8}+\frac{5}{8}=\frac{3+5}{8}=\frac{8}{8}$ |
| | 17:22 | 337.Lp, Ll: Eight. | | |
| 17:58 | | 338.T: Do you see? (Writes 3+5). Three plus… (Tries to get learners' attention). You (to Ln), sit. Again… sit properly, sit properly. | | |
| | 17:43 | 339.Ln: (Pulls her table and sits upright). | | |
| 18:21 | | 340.T: I'll say it again. When these (Points at denominator of both fractions) are the same, take one and put it here (points at denominator of the answer). Do you understand? | | |
| | 18:03 | 341.Lp: I understand. | | |
| 18:33 | | 342.T: (Points at numerators). Take these (3 and 5) and put them here (Points at 3+5). Add three and five. (Points at 3+5). Who is it? | | |

| | | | | |
|---|---|---|---|---|
| | 18:11 | 343.Lp: Eight. | | |
| 18:52 | | 344.T: (Writes = 8/8). Do you understand? Do you understand? Do you understand? | | |
| | 18:22 | 345.Ln: Sixteen, sixteen. | | |
| | 18:22 | 346.Lp, Ll, Lv: Ok, I understand. | | |

**<u>Criteria for adding two fractions with the same denominator:</u>**

- Generate the fractions using criteria for fractional representation shown in evaluative event 1
- Consider the numerators—they are different
- Consider the denominators—they are the same so "take one" of them and write as the denominator in the solution
- Add the numerators
- Write the answer above the denominator.

### Evaluative Event 2.2: Example Two: $\frac{2}{6}+\frac{2}{6}=\frac{4}{6}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 19:05 | | 347.T: Another example. I'll do another example. (Draws a rectangle on the board). What is this? | | |
| 19:17 | 18:40 | 348.Ls: A rectangle. | | |
| 19:21 | | 349.T: (Divides rectangle with a diagonal line). | | |
| | 18:43 | 350.Ln: It's divided into two. | | |
| 19:21 | 18:44 | 351.Lv: One. | | |
| 19:24 | | 352.T: How many? | | |
| | 18:44 | 353.Lp: Two. | | |
| | 18:47 | 354.Ll, Lv, Ln, Lp: Two. | |  |
| 19:27 | | 355.T: (Again divides rectangle). | | |
| 19:30 | 18:51 | 356.Ln, Ll, Lp: Four. | | |
| 19:32 | | 357.T: (Draws another diagonal line). | | |
| 19:35 | 18:55 | 358.Ln, Lv: Six. | | |
| | 18:57 | 359.Ls, Lp: Six. | | |
| | 18:57 | 360.Ll: Eight. | | |
| 19:40 | | 361.T: Listen… I want you to colour two the same and then again colour two the same. Colour these two (points at two parts) the same and these two (points at two parts) the same and these two (points at two parts) in a different colour. | | |
| | 19:10 | 362.Lv: (Raises her hand). | | Teacher draws a rectangle which he divides into six parts. |
| | 19:16 | 363.Lp: Colour two. | | |
| | 19:39 | 364.Ll: (To T) can you sign that again please? I didn't hear you. Sign it again. | | |
| 20:21 | | 365.T: I'll say it again, again, again. Colour two the same. | | |
| 20:29 | 19:47 | 366.Ll: Colour two the same. | | |

| | | | | |
|---|---|---|---|---|
| 20:30 | 19:50 | 367.Lp: (Raises her hand). | | |
| 20:32 | | 368.T: Then again colour two from here (points at rectangle) the same. Two and two the same. | | |
| | 19:56 | 369.(Ll repeats teacher's instructions). | | |
| 20:44 | 20:03 | 370.Ln: Two and two. | | |
| 20:45 | | 371.T: An example, example, example, example. | | |
| | 20:07 | 372.Ll: (To Lp) must we colour two and two and two? | | |
| | 20:08 | 373.Lp: Two, yes. | | |
| 20:50 | | 374.T: Wait, wait. Two in one colour (holds up chalk, holds up a different piece of chalk and drops it). Two in one colour and two in another colour. | | |
| 21:07 | 20:25 | 375.Lv: (Raises her hand). | | |
| 21:08 | | 376.T: (Calls her up to the board). | | |
| 21:18 | | 377.Lv: (Shades two parts in blue and goes to sit down). | | |
| | 20:29 | 378.(Learners have a conversation while she's writing on the board). | | |
| 22:00 | | 379.T: (Holds up a different colour of chalk) two. | | |
| | 21:19 | 380.Ls, Ll: (Raise their hands). | | |
| 22:03 | | 381.T: (Holds the chalk out to Ls). | | 2 |
| 22:04 | 21:20 | 382.Ls: You go (To Ll). | | $\frac{2}{6}+$ |
| 22:05 | | 383.T: (Continues to hold the chalk out to Ls). | | |
| | 21:28 | 384.Lp: Are you scared? | | |
| 22:13 | 21:29 | 385.Ls: (Gets up, goes to the chalkboard and colours two parts in red. He sits down). | | |
| 22:14 | 21:30 | 386.(Learners continue to talk while he draws). | | $\frac{2}{6}+\frac{2}{\ }$ |
| 22:47 | | 387.T: Ok, good, good. | | |
| | 22:05 | 388.Lp: (Raises her hand). Two have no colour. | | $\frac{2}{6}+\frac{2}{6}=$ |
| 22:56 | | 389.T: Listen. What colour is this? Red[36]. | | |
| | 22:15 | 390.Lp: There are two in red. | | |
| | 22:14 | 391.Ll, Lv: Red. | | |
| 23:03 | | 392.T: Good, you know it. Look at me. How many are coloured in blue? | | |
| | 22:33 | 393.Ll, Lp: Two. | | |
| 23:20 | | 394.T: (Writes 2). How many altogether? | | |
| | 22:39 | 395.Ll, Lp, Lv: Six. | | |
| 23:24 | 22:40 | 396.Ls: Three. | | |
| 23:24 | | 397.T: Six (Writes /6. Looks at learners then he writes +). How many, how many, how many? | | |
| 23:35 | 22:50 | 398.Lv: Four. | | |
| 23:38 | 22:52 | 399.Ls: Four. | | |
| 23:38 | | 400.T: … are coloured red? | | |
| 23:40 | 22:55 | 401.Ls, Ln: Four. | | |
| | 22:54 | 402.Ll, Lp: Two. | | |
| 23:41 | | 403.T: (Writes 2/ ). How many altogether? | | |
| 23:44 | 22:59 | 404.Ll, Ls, Lp, Lv: Six. | | $\frac{2}{6}+\frac{2}{6}=\frac{\ }{6}$ |
| 23:45 | 23:59 | 405.Ln: Five, six. | | |

[36] Teacher signs "red" incorrectly.

| | | | | |
|---|---|---|---|---|
| 23:46 | | 406.T: (Writes 6). Do you see? (Writes =) | | |
| | 23:02 | 407.Lp: Is equal to. | | |
| 23:52 | 23:04 | 408.Ll: Two. | | |
| 23:53 | 23:05 | 409.Lp: Two plus two. | | |
| 23:53 | 23:08 | 410.Ln: Two plus six. | | |
| 23:54 | | 411.T: I said take, take who? Take who? | | $\frac{2}{6}+\frac{2}{6}=\frac{2}{6}$ |
| | 23:07 | 412.Lp: Take six, take six, take six. | | |
| | 23:09 | 413.Ll: Two plus two, two plus two. | | |
| | 23:12 | 414.Lv: Three. | | $\frac{2}{6}+\frac{2}{6}=\frac{2+}{6}$ |
| 23:58 | 23:12 | 415.Ls: Take six and put it there. | | |
| 24:00 | 23:14 | 416.Ln: Two. | | |
| 24:02 | | 417.T: (Draws a line and points at space below line). | | $\frac{2}{6}+\frac{2}{6}=\frac{2+2}{6}=\frac{4}{6}$ |
| 24:04 | 23:17 | 418.Ln: Six. | | |
| | 23:18 | 419.Lp, Lv: Six. | | |
| 24:05 | | 420.T: How many sixes? | | |
| 24:05 | 23:19 | 421.Lv, Ll: Six. | | |
| 24:06 | 23:19 | 422.Ln: Two. | | |
| | 23:20 | 423.Lp: Take one. | | |
| 24:06 | | 424.T: Look. (Writes 6 below the line). Take one six. | | |
| | 23:21 | 425.Ll: Take one again. | | |
| 24:10 | 23:23 | 426.Ln, Ll: Two. | | |
| | 23:23 | 427.Lv: (Response not recorded). | | |
| | 23:23 | 428.Lp: Two plus two. | | |
| 24:10 | 23:23 | 429.Ls: Two, one. | | |
| 24:11 | | 430.T: (Points at space above line). | | |
| 24:11 | 23:26 | 431.Ln: Two. | | |
| 24:12 | 23:27 | 432.Ls: One. | | |
| | 23:27 | 433.Ll, Lp: Two. | | |
| 24:13 | | 434.T: (Writes 2 then looks at learners). | | |
| | 23:29 | 435.Lp: Plus. | | |
| 24:16 | 23:30 | 436.Ln: Plus. | | |
| | 23:29 | 437.Ll: Two plus two. | | |
| 24:16 | | 438.T: (Writes +, looks at learners). | | |
| 24:17 | 23:31 | 439.Ln: Six. | | |
| | 23:31 | 440.Ll: Two. It’s finished. Two, two. | | |
| | 23:38 | 441.Lp: It’s finished. | | |
| 24:19 | | 442.T: (Writes 2, looks at learners then writes =. Points at 2+2). Who is it? | | |
| | 23:41 | 443.Ls, Ln, Lp, Ll: Four. | | |
| 24:30 | | 444.T: (Writes 4/ , then looks at the learners). | | |
| 24:33 | 23:46 | 445.Ln: Six. | | |
| 24:33 | 23:46 | 446.Ll: Eight, no, six. | | |
| 24:34 | 23:48 | 447.Ls: Six. | | |
| 24:34 | | 448.T: (Writes 6). | | |

| | | | | |
|---|---|---|---|---|
| | 23:49 | 449.Ll: It's finished. | | |
| 24:36 | | 450.T: Do you understand? Do you understand? Do you understand? | | |
| | 23:51 | 451.Ll: I understand. | | |
| | 23:54 | 452.Lp: I understand, yes, I understand. | | |
| | 23:57 | 453.Lv: I'm ok, ok. | | |

**<u>Criteria for adding fractions with the same denominator:</u>**

- Generate the fractions using criteria for fractional representation shown in previous examples.
- Add the fractions using procedure in EE2.1

## Evaluative Event 3: Subtraction of fractions with a common denominator using a worked example: $\frac{4}{6} - \frac{2}{6} = \frac{2}{6}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 24:47 | | 454.T: (Labels first sum number 1, then writes number 2). Look at me, look at me. (Points at rectangle). Of all of these, how many are coloured in? Of all these, how many are coloured in? | | |
| 25:07 | 24:20 | 455.Ln: Three, four. | | |
| 25:07 | 24:20 | 456.Ll: Four. | | |
| | 24:20 | 457.Lp: Five. | Lp: Five | |
| 25:07 | 24:20 | 458.Ls: (Response not clearly visible). | | $\frac{4}{\ }$ |
| 25:09 | | 459.T: (Writes 4/ and looks at the learners). | | |
| 25:12 | 24:24 | 460.Ln, Ll: Two. | | |
| | 24:24 | 461.Lp, Lv: Six. | | |
| 25:14 | | 462.T: (Points at space below the line). | | $\frac{4}{6} +$ |
| 25:14 | 24:27 | 463.Ln, Ll: Two. | | |
| | 24:27 | 464.Lv, Lp: Six. | | |
| 25:16 | | 465.T: (Writes 6 +). How many, how many have no colour? | | |
| 25:21 | 24:33 | 466.Ls: Four, two. | | |
| | 24:35 | 467.Lv, Lp, Ln: Two. | | |
| 25:24 | 24:35 | 468.Ll: Six. | | $\frac{4}{6} - \frac{2}{\ }$ |
| 25:20 | | 469.T: Out of all of them, how many have no colour? | | |
| 25:26 | 24:38 | 470.Ln, Ls: Two. | | |
| | 24:38 | 471.Ll: Oh! I'm mad. It's two. | | $\frac{4}{6} - \frac{2}{6}$ |
| 25:27 | 24:40 | 472.Ln: Six. | | |
| 25:28 | | 473.T: (Changes + to -. Writes 2/ .Points at space below line). | | |
| 25:35 | 24:47 | 474.Ln: Six. | | |
| | 24:47 | 475.Lp: Six. | | $\frac{4}{6} - \frac{2}{6} =$ |
| 25:36 | | 476.T: (Writes 6. Points at – sign). It's been changed to a minus sign. It has changed to a minus sign. | | |
| | 24:50 | 477.Ll: There's a minus. | | $\frac{4}{6} - \frac{2}{6} = \frac{\ }{\ }$ |
| 25:42 | 24:54 | 478.Ln: Minus. | | |

| | | | | |
|---|---|---|---|---|
| | 24:54 | 479.Lp: Isn't it plus? | | |
| 25:46 | | 480.T: Do you see? It (points at minus) is the same as this (points at +). (Writes =). | | |
| 25:52 | 25:04 | 481.Ln: One. | Ln: One | |
| 25:52 | | 482.Lv: Two. | | |
| 25:52 | | 483.T: (Draws a line) who is it? | | $\frac{4}{6} - \frac{2}{6} = \frac{\quad}{6}$ |
| 25:54 | 25:07 | 484.Ln, Ll: One. | | |
| 25:56 | 25:07 | 485.Ls: Two. | | |
| | 25:07 | 486.Lp: Two. | Lp: Two | |
| 25:56 | | 487.T: (Points at both sixes). What is it? | | |
| 25:59 | 25:09 | 488.Ls: Six. | | $\frac{4}{6} - \frac{2}{6} = \frac{4}{6}$ |
| 25:59 | 25:10 | 489.Ln: One. | | |
| | 25:10 | 490.Lp: Nought. | | |
| 26:00 | 25:10 | 491.Ll: Six, six. | | |
| 26:01 | | 492.T: You take it. (Writes 6 below the line). It's the same. You take six. | | |
| 26:06 | 25:15 | 493.Ln: One. | Ln: One | |
| | 25:15 | 494.Ll: Put one there. | | |
| 26:07 | | 495.T: (Points at 4). | | $\frac{4}{6} - \frac{2}{6} = \frac{4-2}{6} =$ |
| | 25:18 | 496.Ln: One, one, one. | Ln: One, one! | |
| | 25:19 | 497.Lp: (Raises her hand) Four take away two is two. | | |
| 26:12 | | 498.T: (Writes 4). | | |
| 26:13 | 25:24 | 499.(The lesson is interrupted when two boys enter the class). | | |
| 26:15 | | 500.T: Go out (To one boy). | | |
| 26:19 | 25:32 | 501.(One boy goes out and the other (Ly) sits at his desk—he has arrived late at school). | | |
| 26:30 | | 502.T: (Tries to get learners' attention. Points at 4). | | |
| 26:38 | 25:49 | 503.Ln: Four. | | |
| 26:39 | | 504.T: (Points at the space next to four). | | |
| 26:42 | 25:52 | 505.Ln: Minus, minus. | | |
| | 25:52 | 506.Ll: Plus. | | |
| 26:43 | 25:53 | 507.Ly: Two. | | |
| | 25:55 | 508.Lp: Two. | | |
| 26:43 | | 509.T: (Writes - , 2, =). | | |
| | 25:59 | 510.Lp: (To Ly) They watching you over there (refers to video camera). | | |
| | 26:00 | 511.Ll: (To Lp) Why is it minus? | | |
| | 26:02 | 512.Lp: It was all plus now it's minus. Plus was good. | | $\frac{4}{6} - \frac{2}{6} = \frac{4-2}{6} = \frac{2}{6}$ |
| 26:50 | | 513.T: Who is four minus two? Who is four minus two? | | |
| 26:58 | 26:08 | 514.Ln: One. | Ln: One | |
| 26:59 | 26:10 | 515.Ls: Six. | | |
| | 26:10 | 516.Ll: Say it again, say it again. | | |
| 26:59 | 26:11 | 517.Ly: Nought. | | |
| | 26:12 | 518.Lp: It's two. | | |
| 27:00 | | 519.T: What is four minus two? | | |
| 27:03 | 26:14 | 520.Ls, Ly: Nought. | | |
| 27:03 | 26:14 | 521.Ln: One. | | |

| | | | | |
|---|---|---|---|---|
| | 26:14 | 522.Ll: It's two, two. | | |
| 27:04 | | 523.T: (Looks at Ls) four, four… | | |
| 27:06 | 26:16 | 524.Ly: One. | | |
| 27:06 | 26:16 | 525.Ln: One. | | |
| 27:06 | | 526.T: Wait (to Ly). Four minus two (Looks at Ls). | | |
| 27:10 | 26:19 | 527.Ln: One. | Ln: One | |
| | 26:19 | 528.Ll: It's two, two, two. | | |
| | 26:21 | 529.Ly: Two. | Ly: Two | |
| | 26:21 | 530.Lv: Two. It's two. | | |
| | 26:21 | 531.Ls: (Does not respond). | | |
| 27:15 | | 532.T: (Writes 2/, points at space below line). | | |
| | 26:28 | 533.Lv: Six. | | |
| 27:18 | | 534.T: (Writes 6). | | |
| | 26:30 | 535.(Learners chat amongst themselves). | | |
| 27:25 | | 536.T: Do you understand? Do you understand? | | |
| | 26:41 | 537.Lp: You haven't taught him anything (refers to Ly). | | |
| | 26:43 | 538.Ll: That's his problem because he arrived late. | | |

**<u>Criteria for subtracting two fractions with the same denominator:</u>**

- Generate the fractions using criteria for fractional representation shown in previous examples
- Follow the same procedure as for addition.

## Evaluative Event 4: Counting colours in a form board

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 27:36 | | 539.T: (Picks up a form board from the table. Tries to get the learners' attention.) | | |
| 27:45 | 26:55 | 540.Ly: (Continues his conversation.) | | |
| 27:47 | 26:59 | 541.T (to Ly): I said first leave that and show respect. | |  |
| | 27:00 | 542.Ly: Yes, ok. | | |
| | 27:03 | 543.Ll: First learn. Leave the chatting now. | | |
| 27:54 | | 544.T: (Tries to get the learners' attention). Sit properly. Stop pushing the table and sit properly (To Ln). | | |
| | 27:10 | 545.Ll: Sit properly, you have no respect. | | |
| 28:06 | | 546.T: Look here. (Points at different shapes on a form board he is holding). | | |
| 28:09 | 27:19 | 547.Ls: Four. | Ls: Four | The teacher uses a form board similar to the one in the picture above. |
| 28:09 | 27:19 | 548.Ly: (Points at the form board). | | |
| | 27:20 | 549.Ll: (Counts on her fingers). | | |
| 28:10 | | 550.T: Look. (Points at different shapes in piece of form board). | | |
| 28:15 | 27:25 | 551.Ln: Eight | Ln: Eight | |
| 28:15 | 27:25 | 552.Ls: It's a triangle. | | |
| 28:17 | | 553.T: (Continues to point at the shapes). | | |

| | | | | |
|---|---|---|---|---|
| | 27:26 | 554.Ll: There are eight. | | |
| 28:17 | 27:27 | 555.Ly: (Counts on his fingers). Ten. | | |
| 28:19 | 27:29 | 556.Ln: Eight. | Ln: Eight. | |
| 28:23 | | 557.T: (To Ly) Again. | | |
| 28:24 | 27:34 | 558.Ly: One, two, three, four, five, six, seven, eight, nine. Eight. | | |
| | 27:34 | 559.Ll: Nine. | | |
| | 27:35 | 560.Lp: (To Ll). There are eight. | | |
| 28:27 | 27:38 | 561.Ln: Eight, eight. | Ln: Eight, eight. | |
| | 27:38 | 562.Ll: Eight. | | |
| | 27:39 | 563.Ly: Eight. | | |
| 28:29 | 27:40 | 564.Ls: Eight. | | |
| | 27:40 | 565.Lv: One, two, three, four, five, six, seven, eight. | | |
| | 27:41 | 566.Lp: There are eight. | | |
| 28:29 | | 567.T: How many are there? There are eight. Good. (Takes three forms, puts them into the form board and shows it to the learners). | | |
| 28:50 | 28:00 | 568.Ln, Ls: Three. | | |
| 28:56 | | 569.T: How many are there? | | |
| 28:57 | 28:04 | 570.Ln, Ls: Three. | | |
| | 28:06 | 571.Ln, Ls, Ll, Lp: Three. | | |
| 28:59 | | 572.T: What? Three what? Colours. There are three colours. | | |
| | 28:10 | 573.Ll: Colours, colours, colours, three. | | |
| | 28:10 | 574.Ln: Nothing, nothing, nothing, colours three. | | |
| | 28:10 | 575.Ly: There are two colours. | | |
| | 28:10 | 576.Lp: There are two colours, there are two colours. | | |
| | 28:11 | 577.Ls: Plus. | | |
| 29:05 | | 578.T: How many with no colours? | | |
| 29:07 | 28:16 | 579.Ln: Five. | | |
| 29:08 | 28:17 | 580.Ly: One. | | |
| | 28:17 | 581.Lp: Five. | | |
| | 28:17 | 582.Ll: One, two, three, four, five. | | |
| 29:08 | | 583.T: Five? | | |
| 29:09 | 28:19 | 584.Ls: The colour is green. | | |
| 29:11 | | 585.T: (Adds another shape to the form board). | | |
| 29:14 | 28:24 | 586.Ln: There are four in colour. | | |
| | 28:24 | 587.Ll: Four. | | |
| 29:14 | 28:24 | 588.Ls: The colour is red, the colour is red. | | |
| 29:15 | 28:25 | 589.Ly: The colours are the same. | | |
| 29:18 | | 590.T: How many red are there? | | |
| | 28:31 | 591.Lp: There are two in red. | | |
| 29:21 | 28:32 | 592.Ln: Four. | | |
| 29:22 | 28:32 | 593.Ly: Two. | | |
| 29:23 | | 594.T: How many red are there? | | |
| | 28:35 | 595.Ll: There are four in red. | | |

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|---|---|---|---|---|
| 29:27 | 28:36 | 596.Ln: Red, red. There are two. | | |
| | 28:37 | 597.Lv: There are four in red. | | |
| | 28:40 | 598.Ls: Plus two. | | |
| 29:28 | | 599.T: How many are red? | | |
| | 28:43 | 600.Ly: Two. | | |
| 29:30 | 28:43 | 601.Ls: Plus two. | | |
| | 28:42 | 602.Ll: Four. One, two, three, four. | | |
| | 28:43 | 603.Lp, Ln: Two. | | |
| 29:34 | | 604.T: (Looks at Ly). | | |
| 29:34 | 28:44 | 605.Ly: Two. | | |
| 29:35 | | 606.T: Two. | | |
| | 28:45 | 607.Ly: There are two red ones and two green ones. | | |
| | 28:48 | 608.Ln: Plus two of the same is four. | | |
| 29:37 | | 609.T: Two. How many are there altogether? | | |
| 29:41 | 28:50 | 610.Ly: Four. | | |
| 29:42 | | 611.T: All of you on this side (Points at learners on his right. Tries to get their attention). How many are red? | | |
| 29:48 | 28:58 | 612.Ls: Six. | | |
| 29:50 | | 613.T: How many are red here? | | |
| | 29:00 | 614.Ls: Six. | | |
| 29:51 | 29:01 | 615.Ln: Two. | | |
| | 29:01 | 616.Ll, Lp: Two. | | |
| 29:52 | | 617.T: It's two. Altogether how many are there? | | |
| 29:54 | 29:03 | 618.Ln: Altogether there are eight. | Ln: Eight. | |
| | 29:04 | 619.Ll, Lp: Eight. | | |
| 29:54 | 29:04 | 620.Ls: Six. | | |
| 29:56 | | 621.T: Altogether there are eight. How many are green? | | |
| 30:00 | 29:10 | 622.Ln: Eight. | Ln: Eight. | |
| | 29:11 | 623.Ll, Lp: Eight. | | |
| | 29:12 | 624.Lp: Two. | | |
| | 29:13 | 625.Lv: Eight. | | |
| 30:05 | | 626.T: Two. How many are green? Two. | | |
| | 29:15 | 627.Ll: There are two in green and two in red. Altogether there are four. | | |
| 30:06 | 29:17 | 628.Ls: Plus two. | | |
| | 29:17 | 629.Lp: Altogether there are four. | | |
| | 29:18 | 630.Ln: Altogether… | | |
| 30:09 | | 631.T: (Looking at Ll). How many are there altogether? | | |
| | 29:20 | 632.Lp: Altogether there are eight. | | |
| | 29:20 | 633.Lv: Eight. | | |
| | 29:21 | 634.Ll: Altogether there are four in colour and altogether there are eight. I'm finished. | | |
| 30:10 | 29:21 | 635.Ln: Altogether there are four, altogether there are five. | | |
| | 29:21 | 636.Ls: Plus two, plus two. | | |
| 30:13 | 29:23 | 637.Ly: Four. | | |

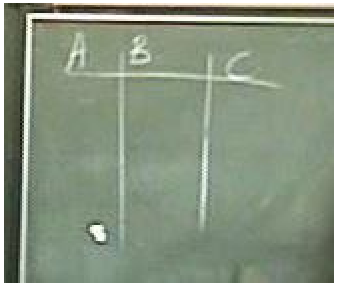
| | | | | |
|---|---|---|---|---|
| 30:16 | | 638.Ly: (Tries to get teacher's attention). | | |

**Comments:**

- Teacher seems to be using the form board to emphasise counting objects in different colours.
- Counting colours is a major part of his procedure for generating a fraction.

## Evaluative Event 5: Adding fractions with a common denominator

### Evaluative Event 5.1: Example One: $\frac{3}{8}+\frac{2}{8}=\frac{5}{8}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 30:19 | 29:27 | 639.T: (Goes to get paper from the table). | | |
| 30:24 | 29:35 | 640.T: (Hands a sheet of paper out to every second child). | | |
| | 29:36 | 641.(Learners chat amongst themselves while teacher is busy). | | |
| 31:35 | 30:46 | 642.T: (Hands out crayons to each pair). Do you know? Do you know? (Tries to get the learners' attention). Do you know about stealing? (Tries to get Ls and Ly's attention). Do you know about stealing? All of you, no stealing. Please, you know you mustn't steal. | | |
| 32:15 | 31:26 | 643.Ly: I'll watch all of them, I'll watch them. I'll know. | | |
| 32:18 | | 644.T: I know you steal. | | |
| 32:20 | 31:33 | 645.Ls: I don't steal. | | |
| | 31:34 | 646.Ll: I won't steal this. | | |
| 32:23 | | 647.T: (Tries to get the learners' attention). Where is the red crayon? Red, red, red. | | |
| | 31:50 | 648.Lp: Red, red. It's locked up in there (refers to storeroom). | | |
| | 31:55 | 649.(Learners are writing or chatting). | | |
| 33:08 | | 650.T: (Tries to get their attention but they do not look at him. Draws a scoreboard on the board). I've made that. Good. (Points at the board). (Tries to get learners' attention). Look at me, look at me. | |  |
| | 32:52 | 651.Ll: I want that quickly. Quickly. We are going to draw. Look at that. (Points at the board). | | |
| | 33:03 | 652.Ln: That? (Points at the board). Maybe we must draw the bread. | | |
| | 33:10 | 653.Ll: Wait, wait. We must look now. | | |
| | 33:13 | 654.Ln: Who is first? Who is A? | | |
| | 33:15 | 655.Ll: I don't know who is A, B or C. | | |
| 34:07 | 33:18 | 656.T: You are A[37] (to Ly and Ls), you are B (To Ln and Ll) and you are C (To Lp and Lv). | | |
| | 33:22 | 657.Ll: Oh, they are A, we are B and they are C. | | |
| | 33:22 | 658.Ls (to Ly): We are B, no we are A. B is going to lose. | | |
| 34:11 | 33:22 | 659.T: You are A, B and C (To the three pairs). A, B, C. First, first, first. Draw a rectangle, draw a rectangle. | | Teacher draws a scoreboard |
| | 33:48 | 660.Ll: Quickly, quickly. A rectangle is the same as that (Points at the rectangle on the | | |

[37] Teacher signs "A" incorrectly

| | | | | |
|---|---|---|---|---|
| | 33:48 | board). | | |
| 34:34 | 33:50 | 661.(Some learners start drawing). | | |
| 34:40 | 33:51 | 662.T: (Waves a piece of cardboard at Ln). | | |
| 34:45 | 33:56 | 663.Ln: (Continues to draw). | | |
| 34:52 | 34:03 | 664.T: Wait. What did I tell you? What did I say? What did I tell you? | | |
| 34:55 | | 665.Ln: (Points at her page) a rectangle. | | |
| | 34:05 | 666.T: A rectangle…(Gets upset) | | |
| 34:57 | | 667.Ln: Oh! (Realises she's made a mistake) | | |
| | | 668.T: I told you to draw a rectangle only. Then stop and look at me. What did I say? (Goes to | | |
| 35:19 | | Ls). Wait. Listen. (Picks up his ruler). Where are your rulers? Where are your rulers? | | |
| 35:19 | 34:14 | 669.Ln: Give me that one. | | |
| | 34:15 | 670.Ls: No, it's mine. | | |
| | 34:19 | 671.Lp: He's mad (Refers to Ls). | | |
| 35:28 | 34:20 | 672.Ln: We need a ruler. | | |
| 35:33 | | 673.Ll: (Tries to get teacher's attention). Please can we have that one (points at teacher's | | |
| | 34:35 | table)? | | |
| | 34:42 | 674.T: (Points at the window then fetches ruler lying on the window sill and gives it to Ll and | | |
| | 35:03 | Ln). | | |
| | 35:05 | 675.Ll: Good. That's for us. You are too late (To Group C). | | |
| 36:05 | | 676.(The learners are working). | | |
| | | 677.Lp (To Ll): Must we draw that (points at the board)? | | |
| 36:23 | | 678.Lv: Yes | | |
| 36:26 | | 679.T: (Tries to get their attention). Quickly, quickly, quickly. (Taps Lv on the arm). I said draw | | |
| 36:27 | | there. I told you to draw. | | |
| 36:27 | | 680.Lp: I didn't hear what he said. | | |
| 36:30 | | 681.Ll: You must draw a rectangle. | | |
| 36:29 | | 682.T: I told you what to do. | | |
| 36:33 | | 683.Ln: I said so. | | |
| 36:38 | | 684.Lp: I didn't hear. Get us an eraser (To Lv). | | |
| 36:34 | | 685.Ll: Look there (Points at the board). We must draw that. | | |
| 36:41 | | 686.Ln: It's the one next to the cake. | | |
| 36:46 | | 687.Ll: Be quick. | | |
| 36:51 | 35:48 | 688.Lv: (Gets up to fetch another page). | | |
| 36:54 | 35:49 | 689.Ll: (To Lv). Listen, you must draw a rectangle only. | | |
| 36:54 | 35:50 | 690.(The learners are busy drawing) | | |
| | | 691.T: (To Ln) Where is red? Where is red? | | |
| | 35:54 | 692.Ln: Here it is (Shows the red pencil crayon). | | |
| | 35:58 | 693.T: Where is red? Where is red? (Goes to Lp). Where is it? | | |
| | | 694.Lv: He wants the red pencil crayon. | | |
| 37:07 | 36:03 | 695.Ll: We don't have it | | |
| 37:13 | | 696.Ln: Please give me red, red, red (to Lp). | | |
| | 36:11 | 697.(Lp and Lv don't have a red pencil crayon). | | |
| 37:17 | | 698.Ln: Just leave it then. I want a red pencil (To Ls) | | |

| | | | | |
|---|---|---|---|---|
| | 36:14 | 699.T: Quickly, quickly. Listen. | | |
| | 36:17 | 700.Lp: Must I draw a circle? | | |
| | 36:19 | 701.T: Wait, wait. | | |
| 37:17 | | 702.Lv: Quickly, quickly. We are late. | | |
| 37:19 | | 703.Ll: I told you they want to finish quickly. | | |
| 37:22 | | 704.Ln: Just leave them. | | |
| | 36:24 | 705.(Ls and Ly are playing and not paying attention). | | |
| 37:29 | 36:26 | 706.T: Listen… (To Ly) the time, listen, the time. | | |
| | 36:27 | 707.Ly: We're done. | | |
| | 36:28 | 708.Lp: (Gives Ln a pencil crayon). | | |
| | 36:29 | 709.Ln (to T): Just wait. | | |
| 37:34 | | 710.Lv: (To Lp) Quickly, quickly. | | |
| | 36:30 | 711.Lp: It's done (To Lv). | | |
| 37:53 | | 712.Lp (to T): We drew the rectangle, the rectangle. | | |
| | 36:31 | 713.T: Wait, wait. (Watches Ly sharpening his pencil). | | |
| 37:57 | | 714.Lp: Oh, I must wait. | | |
| 38:01 | | 715.T: Wait. | | |
| 38:03 | | 716.(Learners are talking and working). | | |
| 38:18 | | 717.Lp: (Calls teacher) She drew a triangle. | | |
| 38:27 | 37:24 | 718.T: (To Lp) Wait, wait. (To Ls) quickly, quickly. That's good, good. Quickly. | | |
| | 37:25 | 719.(Learners are drawing). | | |
| 38:28 | | 720.T: Listen. Divide it into eight parts. | | |
| 38:32 | 37:31 | 721.Ll: (Points at rectangle on the board) Divide it into eight parts (to Ln). | | |
| 38:33 | | 722.Ll: Eight. | | |
| 38:36 | | 723.T: Divide it into eight parts. (Goes to Lp). Use this. (Refers to piece of cardboard). | | |
| 38:39 | | 724.Ll: (To Ln). Use the ruler. | | |
| 38:40 | | 725.T: (To Ln). Use the ruler. | | |
| 38:47 | | 726.(The learners are working). | | |
| 38:47 | | 727.Ll: (To Ls).You must divide it into eight parts. | | |
| 38:54 | | 728.Ls: Eight. | | |
| 38:54 | | 729.T: (To Ls) divide it into eight parts. | | |
| 38:55 | | 730.Ls: (To Ly). Divide it into eight parts. | | |
| 38:58 | | 731.Lv, Lp: (Raise their hands). | | |
| 39:03 | | 732.T: Are you finished, finished? | | |
| 39:04 | | 733.Lv: Yes. | | |
| 39:10 | 38:11 | 734.T: Two. Listen. Colour two in blue. Colour two in blue. | | |
| 39:12 | 38:13 | 735.Ll: Colour two in blue. (Looks for the blue pencil crayon). | | |
| 39:14 | 38:14 | 736.(Learners are working.) | | |
| 39:15 | 38:15 | 737.Ll: We want that (Refers to pencil crayon). | | |
| 39:17 | 38:17 | 738.T: (Points at something that has fallen on the floor). | | |
| 39:21 | 38:21 | 739.Ln: We want that blue. | | |
| 39:24 | | 740.Ll: (Gives Ln the pencil crayon). Colour two in blue, colour in two. | | |
| 39:25 | | 741.T: (Gives a pencil crayon to group A). Two in blue. | | |

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|---|---|---|---|---|
| 39:30 | | 742.Lp: (Calls E. Covers her work with the cardboard). We're done. | | |
| | | 743.T: Wait, wait. | | |
| 39:41 | 38:42 | 744.(Learners talk amongst themselves). | | |
| 39:44 | 38:45 | 745.T: Three. Look at me, look at me. (Tries to get their attention). Three in yellow. Colour | | |
| 39:44 | 38:46 | three in yellow. | | |
| 39:45 | | 746.Ll: (Gives Ln the yellow pencil crayon). Three in this. | | |
| 39:49 | 38:50 | 747.Lp: Three? Three in yellow? | | |
| 39:50 | | 748.(Siren signals end of period). | | |
| 39:54 | 38:54 | 749.T: Three in yellow. | | |
| 40:08 | | 750.Ll: Three in yellow? Three in yellow? | | |
| 40:14 | | 751.T: Yes, three in yellow, three in yellow. | | |
| 40:16 | | 752.(Learners are drawing and colouring) | | |
| 40:20 | | 753.T: One in red. One in red. | | |
| 40:21 | | 754.Lp: How many in red? | | |
| 40:23 | 39:26 | 755.T: One in red. | | |
| 40:35 | | 756.Lv: We don't have red. | | |
| 40:38 | 39:42 | 757.Ll: Borrow from them (points at pair A). | | |
| 40:42 | 39:44 | 758.Lp: (To pair A). Please can I have one red pencil crayon? Give me one red pencil crayon. | | |
| 40:46 | | (To E) they don't want to give it to us. | | |
| 40:48 | 39:51 | 759.Lp: Give us your red pencil crayon. You finished with it. | | |
| 40:50 | 39:54 | 760.Ll: (Gives the pencil crayon to Lp). We're finished (to E). | | |
| 40:51 | 39:55 | 761.T: Two in green. Two in green. | | |
| 40:54 | | 762.Ll: (Gives the green pencil crayon to Ln). Colour in those (Points at their drawing). | | |
| 40:56 | | 763.Lv: We're done. (Gets up from her seat). | | |
| 41:02 | | 764.Ll: (To Lp and Ln). You must do two in green. | | |
| 41:09 | | 765.Lp: We didn't get a green pencil crayon when he handed them out. | | |
| 41:13 | 40:16 | 766.Lv: (Goes to Ln). There it is. (She stands and waits. She chats to Ly). | | |
| 41:14 | | 767.Lv: Quickly, quickly (To Ly). (She returns to her desk). They are taking long (To Lp). | | |
| 41:15 | | 768.Lp: (Complains about the pencil crayon). | | |
| 41:16 | | 769.Ln (Finishes and gives them the pencil crayon). | | |
| 41:16 | | 770.Ll, Ln: We're done. | | |
| 41:18 | | 771.Lp: How many in green? How many in green? | | |
| 41:19 | | 772.Lv: Two. | | |
| 41:33 | | 773.T: Two. | | |
| 41:34 | | 774.Ly: (Tries to get Lp's attention). | | |
| 41:39 | | 775.(Learners are drawing). | | |
| 41:40 | | 776.T: (To Ls). Three in yellow, three in yellow. | | |
| 41:45 | | 777.Ls: Three in yellow there. | | |
| 42:46 | 41:36 | 778.T: Quickly, quickly. The time is moving. Three. The time is moving. | | |
| 42:49 | 41:37 | 779.(Ly chats to the others and does not assist Ls). | | |
| 43:03 | 41:53 | 780.(Some learners are still finishing, others chatting amongst themselves). | | |
| | 41:54 | 781.T: (To Ls). Three, three. | | |
| 43:05 | 41:58 | 782.(The teacher and learners wait till Ls has finished colouring in). | | |

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|---|---|---|---|---|
| | 41:59 | 783.T: (To Ll). Are you done? | | |
| 43:09 | 42:00 | 784.Ll: We're done. We finished first, then them (refers to group C). Give us a point there! | | |
| | 42:01 | 785.T: (To Ll) wait, wait. (To Ls) the time, the time. | | |
| 43:11 | 42:02 | 786.Ls: Green? Green? | | |
| 43:14 | 42:04 | 787.T: One red, one red. | | |
| 43:16 | 42:06 | 788.Ll: (Tries to get teacher's attention). Give us one point. | | |
| 43:19 | 42:08 | 789.Ly: (To Ln). Give us that! Give us the green. | | |
| 43:19 | 42:10 | 790.Ls: Give it. | | |
| 43:24 | 42:11 | 791.Ln: Gives them the pencil crayon. | | |
| | 42:15 | 792.Ls: (To T): One red? | | |
| 43:28 | | 793.T: And two in blue. | | |
| 43:28 | 42:18 | 794.Ls: (Continues to colour in). | | |
| | 42:19 | 795.Ll: Give us one point, give us one point. | | |
| 44:16 | 43:07 | 796.T: Wait, wait. | | |
| 44:17 | | 797.Ls: (Continues to colour). | | |
| 44:24 | 43:14 | 798.(The other learners chat amongst themselves). | | |
| 44:30 | 43:21 | 799.T: (To Lp) let me see your work. | | |
| 44:31 | | 800.Lp: (Lifts up the cardboard to show her work). | | |
| 44:32 | 43:24 | 801.T: The time is moving (To Ls). | | |
| 44:34 | 43:27 | 802.Ll: Start, start. | | |
| | | 803.T: Listen. | | |
| 44:53 | 43:44 | 804.Ln: Start. | | |
| 44:57 | | 805.T: Now, now listen. Now, don't tell. You may only discuss with your team mate. Discuss | | |
| 45:08 | 43:59 | with each other only. Don't tell the others. Push your desks back. | | |
| 45:09 | 44:00 | 806.(Learners move their desks back). | | |
| | | 807.T: Look at me, look at me. (Looks at Ly). Are you asleep? Are you asleep? | | |
| 45:34 | 44:25 | 808.Ly: No. | | |
| | 44:32 | 809.(Learners are moving their desks and settling down. Groups B and C argue about the | | |
| 45:40 | | pencil crayons). | | |
| | 44:37 | 810.T: Look at me. The time is moving (tries to get the learners' attention). | | |
| 45:47 | | 811.Lp: Look at him (to Group B). | | |
| | | 812.T: Listen to me. I'm not going to repeat it. I'm not going to repeat it. | | |
| | 44:50 | 813.Lp: (Still chatting to her team mate). | | |
| 46:00 | 44:52 | 814.T: The first time only. Look at me. I'm not going to say it again. The first time only. Look | | |
| 46:01 | 44:53 | at me. How many colours are there? | | |
| | 44:53 | 815.Lp: There are two in blue. | | |
| 46:02 | | 816.Ln: Four. | | |
| | 44:54 | 817.Ls: Two. | | |
| | 44:55 | 818.Ll: Two. | | |
| | 44:57 | 819.T: How many colours are there? | | |
| 46:05 | | 820.Lp: There are two in blue. | | |
| | 44:59 | 821.Ls: Blue. | | |
| 46:08 | 45:00 | 822.Ly (To Ls): Yellow, yellow. | | |

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|---|---|---|---|---|
| | 45:02 | 823.T: Two in blue. How many green? | | |
| 46:08 | | 824.Lp: Two. | | |
| 46:12 | | 825.Ls: Three in yellow. | | |
| 46:13 | 45:04 | 826.Ly: Three. | Ly: Three | |
| 46:13 | 45:05 | 827.Lv: Two. | | |
| 46:13 | 45:05 | 828.T: (To Ls) How many are green? Green? | | |
| | 45:05 | 829.Ly: Two. | Ly: Two | |
| 46:14 | | 830.Ls: Two. | | |
| | 45:06 | 831.Ln: Three in yellow. | | |
| | 45:09 | 832.Ll: Two. | | |
| 46:17 | | 833.T: Yellow, yellow, yellow? | | |
| 46:19 | 45:11 | 834.Lp: Three in yellow. Three. | | |
| | 45:12 | 835.Ll: Three. | | |
| | 45:12 | 836.T: Red, red? | | |
| 46:19 | | 837.Ln: Three. | | |
| | 45:13 | 838.Lp, Ln, Ls, Lv: One. | Lp: One | |
| | 45:14 | 839.Ll: Two. | | |
| 46:24 | | 840.T: Red? | | |
| | 45:19 | 841.Ln, Lp, Ls, Ll: One. | Lp, Ls: One | |
| 46:29 | | 842.Lv: One. | | |
| | 45:22 | 843.T: One. One in red. How many in blue? | | |
| 46:32 | | 844.Ln, Ls, Ll, Lp: Two. | | |
| | 45:25 | 845.T: Yellow? | | |
| 46:34 | | 846.Ln, Ls, Ll, Lp: Three. | | |
| | 45:36 | 847.T: Red? | | |
| | 45:38 | 848.Ln, Ls, Lp: One. | | |
| 46:43 | | 849.T: Good. Ok. Wait. Listen. Write plus. Wait (Looks at Ll). | | |
| | 45:41 | 850.Ll: (Looking out of the window). | | |
| 46:55 | | 851.Lp: (To Ll) Look at him. | | |
| | 45:49 | 852.T: I'll say it again. I'll say it again. Why are you looking over there? (To Ll). Listen. | | |
| | 45:53 | 853.Ll: I'm listening, I'm listening. | | |
| 47:01 | | 854.T: Add the yellow. Write it down. The yellow, write it down. | | |
| | 45:57 | 855.Lp: Three. | | |
| | 46:00 | 856.Ll: The yellow? | | |
| 47:12 | | 857.T: Write it down. Write down the yellow. The yellow, write it. | | |
| | 46:01 | 858.Lv: (To Lp). Write three. | | |
| | 46:04 | 859.(Learners are discussing and writing). | | |
| 47:17 | | 860.T: Write the yellow. | | |
| | 46:06 | 861.Lv: We're done. We're done. | | |
| | 46:06 | 862.Ll: (To Ln). Write the yellow. | | |
| | 46:08 | 863.T: Add the yellow and the blue. | | |
| | 46:14 | 864.Lp: Blue? | | |
| | 46:14 | 865.Ll: Must we write our names? | | |

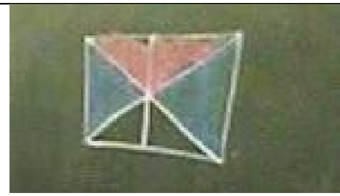
| | | | | |
|---|---|---|---|---|
| 47:30 | | 866.Lp, Lv: We're done. | | |
| | | 867.Lv: We've done the yellow. | | |
| | 46:25 | 868.Lp: Blue. We've done blue. | | |
| | 46:27 | 869.T: (Goes to the board). Do it the same as this. Remember, remember (points at fractions | | |
| 47:41 | | on the board) it must be the same as this. | | |
| | | 870.Lp: Oh! | | |
| | 46:45 | 871.Ll: It must be like that. | | |
| | 46:48 | 872.T: Make yours, make yours the same as this (Points at sum of fractions on the board). | | |
| | 46:50 | Each group must do it. It must be the same as this (Points at the board). | | |
| 47:59 | | 873.Lv: It's two. Finished. | | |
| | 46:52 | 874.Lp (to E): Is it plus two? Must I write plus two here? | | |
| 48:02 | | 875.Lv: Yes, yes! | | |
| 48:04 | | 876.T: Yes. | | |
| 48:09 | 47:00 | 877.Lp: How many yellow? Must I write it here? | | |
| | 47:06 | 878.Lv: Two. | | |
| | 47:08 | 879.T: I said yellow and blue. | | |
| 48:17 | 47:10 | 880.(Learners continue working in their pairs). | | |
| | | 881.Ly: I don't understand that (points at the board). | | |
| 48:20 | 47:12 | 882.Ls: Yellow, yellow! | | |
| 48:22 | 47:14 | 883.T: (To Ly). Do it the same as that (Points at the board). Make it the same (Points at their | | |
| 48:24 | 47:16 | sheet of paper). | | |
| 48:32 | 47:24 | 884.(An announcement is made on the intercom). | | |
| 48:33 | 47:26 | 885.Ly: The same as that? Must I write it like that? (Points at the board). | | |
| 48:35 | 47:28 | 886.T: Yes. | | |
| | 47:30 | 887.Ln: (To Ly). I want the green. Give me green. | | |
| 48:43 | | 888.Ly: She (Lp) has it. | | |
| | 47:35 | 889.Ln: The green, the green! | | |
| 48:47 | | 890.Ly: (Refuses). | | |
| | 47:38 | 891.T: What do you want? | | |
| 48:49 | | 892.Ll: Please I want green. | | |
| 48:49 | 47:42 | 893.T: What? | | |
| 48:51 | | 894.Ll: I want the green, green. | | |
| 48:53 | 47:44 | 895.T: It's yellow and blue. | | |
| 48:55 | 47:47 | 896.Ll: Green, green, green! | | |
| 48:57 | 47:50 | 897.T: For what? To do what? | | |
| 49:00 | 47:51 | 898.Ll: (Points at her sheet of paper). | | |
| 49:01 | 47:51 | 899.T: Take this (gives her a pencil crayon). | | |
| | 47:52 | 900.Ll: (Starts writing). | | |
| 49:02 | 47:54 | 901.Lp: He's calling (Points at Ly). | | |
| 49:04 | 47:58 | 902.T: (Walks over to group A). | | |
| 49:05 | 47:58 | 903.Ly: (Calls teacher) I don't understand. | | |
| 49:09 | 48:01 | 904.T: Listen. How many yellow are there? | | |
| 49:14 | 48:06 | 905.Ly: Three. | Ly: Three. | |

| | | | | |
|---|---|---|---|---|
| | 48:07 | 906.T: Write it there (points at paper). | | |
| | 48:08 | 907.(Ly writes while T looks on). | | |
| 49:21 | 48:14 | 908.T: Blue, blue, blue. | | |
| 49:21 | 48:14 | 909.Ly: Green, green. Two in blue. (He continues to write while educator looks on). | | |
| 49:22 | 48:15 | 910.Ls: Two in blue! | | |
| 49:26 | 48:18 | 911.T: How many… | | |
| 49:27 | 48:19 | 912.Ly: Five. | | |
| 49:27 | 48:20 | 913.T: How many are there altogether? | | |
| 49:29 | 48:21 | 914.Ly: Eight. | | |
| 49:32 | 48:23 | 915.T: So how do you write it? | | |
| 49:34 | 48:26 | 916.Ly: Eight. | | |
| 49:35 | 48:27 | 917.T: How do you write eight? | | |
| | 48:30 | 918.Ly: There it is (points at his page) eight. | | |
| | 48:28 | 919.Ls: It's minus, minus, minus. | | |
| 49:40 | | 920.T: (To Ls). You! (Behave). (Goes to group C). | | |
| 49:46 | | 921.Ls (to Ly): Look there! (Points at the board). | | |
| 49:48 | | 922.Lp: (Calls teacher over to check her work). | | |
| | 48:45 | 923.T: I said, I said yellow and blue. Yellow and blue. | | |
| 49:58 | | 924.Lp: That's finished. | | |
| 50:01 | | 925.T: Stop. Yellow and blue only. Yellow and blue then you stop. | | |
| 50:02 | 48:55 | 926.Lp: Yellow, yellow then stop. Red, green, blue, red … | | |
| 50:03 | 48:55 | 927.T: Leave the red and leave the green. | | |
| 50:10 | 49:03 | 928.Lp: Ok. | | |
| | | 929.Ll: (calls teacher over to check their work). | | |
| | | 930.T: (Walks to group B, looks at their work and walks away). | | |
| | | 931.Ln: Write it over there (Points at the scoreboard). | | |

**Comments:**

- The teacher instructed the learners to draw a rectangle which needed to be portioned into eight parts.
- They were required to generate fractions using the segments shaded in blue and yellow using the teacher's exposited procedure.
- They were expected to add the fractions using the teacher's exposited procedure.
- The learners were unable to reproduce the required procedures.

## Evaluative Event 5.1.1: Example Two: $\frac{2}{6}+\frac{2}{6}=\frac{4}{6}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 50:13 | | 932.T: Let's do it again, again, again (tries to get the learners attention). | |  |
| 50:33 | 49:19 | 933.(Lv, Ly and Ls continue to chat). | | |
| 50:45 | | 934.T: (Erases part of the board and again tries to get their attention). Again, again, again, again. | | |
| 50:57 | 49:49 | 935.(The teacher is interrupted by someone at the door. He goes out for a while, then returns). | | |
| 51:11 | 49:58 | 936.T: (Tries to get learners' attention). Again, again, again, again. (Points at the rectangle drawn on the board) how many are blue? | | Teacher refers learners to rectangle drawn during Evaluative Event 2.2 |
| | 50:22 | 937.Ln, Lp, Lv: Two. | | |
| | 50:25 | 938.Lp: Plus. | | |
| 51:37 | | 939.T: (Writes 2). Ok. How many altogether? | | |
| 51:42 | 50:29 | 940.Ln: Five. | | 2 |
| 51:42 | 50:29 | 941.Ly: Four. | | |
| | 50:29 | 942.Lp: Six. | | |
| 51:43 | | 943.T: How many are there altogether? | Ls: Eight | |
| 51:45 | 50:31 | 944.Ln: Six. | | |
| 51:45 | 50:31 | 945.Ls: Eight. | | |
| 51:45 | 50:31 | 946.Ly: Five. | | |
| | 50:31 | 947.Lp: Six (Tries to get teacher's attention). It's six. | | $\frac{2}{6}+$ |
| | 50:32 | 948.Ly: Five. One, two, three, four, five, six, seven. Seven. | | |
| | 50:40 | 949.Lp: Plus. | | |
| 51:50 | | 950.T: (Writes /6 +). How many are red? | | |
| 51:58 | 50:44 | 951.Ls: Two. | | |
| | 50:44 | 952.Ln: Eight. | | |
| | 50:44 | 953.Lp: Two. | | |
| | 50:46 | 954.Ly: Eight. | | |
| 51:59 | | 955.T: Look here (Refers to the rectangle). How many are red? How many? | Ly: Two | $\frac{2}{6}+\frac{2}{\ }$ |
| 52:02 | 50:47 | 956.Ls: Four. | | |
| 52:02 | 50:47 | 957.Ly: Two. | | |
| | 50:47 | 958.Lp: Two. | | |
| | 50:47 | 959.Ln: Five. | | |
| 52:03 | | 960.T: (Writes 2/ ). How many parts altogether? | | |
| 52:08 | 50:55 | 961.Ln: Six. | | $\frac{2}{6}+\frac{2}{6}=$ |
| 52:08 | 50:56 | 962.Ly: Four. | | |
| 52:08 | 52:09 | 963.T: Six. How many are there altogether? Six. | | $\frac{2}{6}+\frac{2}{6}=\frac{2+2}{6}=$ |
| | 50:59 | 964.Ln, Lp: Six. | | |
| 52:11 | 50:59 | 965.Ly: Seven. | | |
| 52:12 | | 966.T: (Looks disbelievingly at Ly). | | $\frac{2}{6}+\frac{2}{6}=\frac{2+2}{6}=\frac{4}{\ }$ |

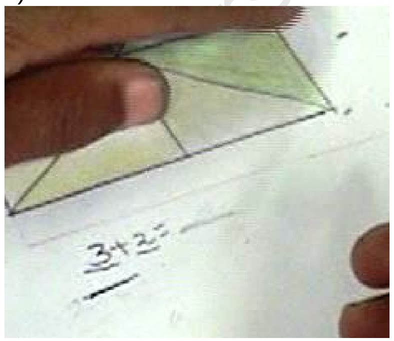
| | | | | |
|---|---|---|---|---|
| 52:13 | 51:00 | 967.Ly: Six. | | $\frac{2}{6}+\frac{2}{6}=\frac{2+2}{6}=\frac{4}{6}$ |
| | 51:00 | 968.Ls: Eight. | | |
| | 52:15 | 969.T: (Writes 6) Two… (Tries to get their attention. Writes =). Look. Take one six (Points at the two denominators. | | |
| | 51:14 | 970.Lp: Take a six, take a six. Take one. | | |
| | 51:17 | 971.Ln: Four. | | |
| 52:31 | | 972.T: Draws a line and writes 6 below it. Points at 2 and writes 2 + 2 =) Who is it? | | |
| 52:44 | | 973.Ln: Four. | | |
| 52:44 | | 974.T: (Writes 4/ then looks at the learners). | | |
| 52:47 | | 975.Ln: Six. | | |
| | 51:34 | 976.Lv: Six, four. | | |
| 52:47 | | 977.T: (Writes 6). Now do yours. Do yours the same as that. | | |
| | 51:37 | 978.Lp: Oh! | | |

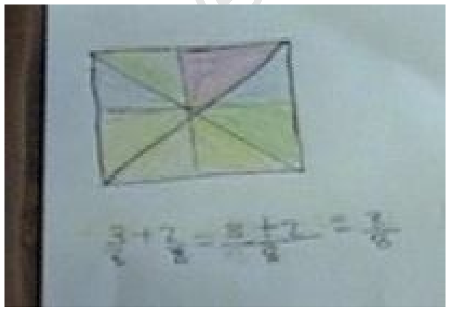
**<u>Criteria for adding two fractions with the same denominator:</u>**

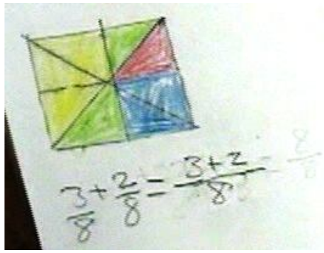
- The teacher repeated his procedure for generating and adding two fractions using the same example he presented in EE2.2.

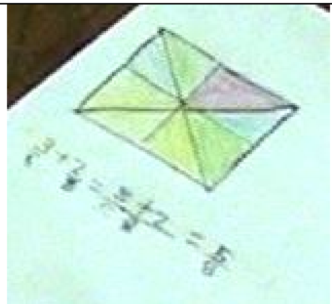
## Evaluative Event 5.1: Example One: $\frac{3}{8}+\frac{2}{8}=\frac{5}{8}$ cont.

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 52:59 | 51:40 | 979.(Learners discuss and work within their pairs). | | |
| 53:09 | 51:57 | 980.T: (Looks at Lp). Wait, listen. (Points at her book). Erase that. | | |
| 53:16 | 52:05 | 981.Lp: (To group B) give me an eraser. | | |
| 53:18 | 52:06 | 982.Ln, Ll: (Shake their heads). | | |
| 53:18 | 52:06 | 983.T: (Looks at Ll and Ln's work then goes to Ls and Ly). Look, I said three (Points at their work). One, two, three. | | |
| 53:30 | 52:17 | 984.Ls: It's three. | | |
| 53:31 | | 985.T: How many altogether? Altogether how many? | | |
| 53:34 | 52:22 | 986.Ls: Altogether there are six. | | |
| 53:34 | 52:22 | 987.Ly: Eight. | | |
| 53:34 | | 988.T: Yes, eight. Erase this (Points at their work). | | |
| 53:39 | | 989.Ly: I told you it's eight. | | |
| 53:46 | | 990.T: (Look's at group B's work). | | |
| 53:46 | 52:34 | 991.Lp: (Tries to get teacher's attention). | | |
| 53:48 | | 992.Ll: (To Ln) Eight. I'm telling you, write eight. It's eight. | | |
| 54:08 | | 993.T: You two. Wait. You said there are three yellow. That's correct. You said two in blue. | | |
| 54:17 | | 994.Ln, Ll: Two. | | |
| 54:19 | | 995.T: And the other one? Is it finished? (Points at their work). Erase this. | | |
| 54:28 | 53:06 | 996.Ln: (To Lv) give us an eraser. | | |
| 54:30 | 53:09 | 997.T: (Walks to group C). | | |

| | | | | |
|---|---|---|---|---|
| | 53:11 | 998.Lp: Look here. Is it two over? | | |
| 54:37 | 53:17 | 999.T: (Goes to group A). Erase this. | | |
| 54:40 | 53:21 | 1000. Ly: (Erases his work). | | |
| 54:46 | | 1001. T: Again. Three. How many are there altogether? | | |
| 54:50 | | 1002. Ly: Eight. | | |
| 54:51 | | 1003. T: Eight (Points at their work). | | |
| 54:55 | | 1004. Ly: (Is distracted by Ln as she takes the eraser). Eight. | | |
| 54:59 | | 1005. T: (Points at his work). Eight. Over eight. | | |
| 55:05 | | 1006. Ly: Eight? | | |
| 55:05 | | 1007. T: Eight. | | |
| 55:05 | | 1008. Ls: Yes! | | |
| 55:06 | 53:49 | 1009. Ly: (Writes while teacher looks on). | | |
| 55:10 | | 1010. T: Make a line, make a line. | | |
| | 53:58 | 1011. Ly: (Draws a line below three) | | |
| | | 1012. Group A have written: 3+2= __ <br> __ | | |
| 55:16 | 53:59 | 1013. Lv: (Tries to get teacher's attention). | | |
| 55:18 | | 1014. T: (Goes to the board and points at 2/6). What is this? | | |
| 55:24 | | 1015. Ly: Two. | | |
| 55:25 | | 1016. T: (Points at the line of 2/6). | | |
| 55:25 | | 1017. Ly: I have it! | | |
| 55:27 | | 1018. T: (Redraws the line). | | |
| 55:28 | | 1019. Ly: I have it. | | |
| 55:30 | | 1020. T: Where is it? | | |
| 55:30 | | 1021. Ly: I've already done it. | | |
| 55:32 | 54:20 | 1022. T: (Walks over to Ly's desk, takes his pencil and writes on his page. Draws a line below the three and the two). <br>   <br> **Group A's work.** | | |
| 55:47 | | 1023. Ls: He drew lines. | | |
| 55:50 | | 1024. Ly: It's lines. | | |

| | | | | |
|---|---|---|---|---|
| 55:51 | | 1025. Ls: It’s the same as that (Points at sum on the board). | | |
| 55:55 | 54:37 | 1026. T: (Walks over to group C and tells them to erase something from their page. He looks at group B’s work). Who is that? (Pointing to their work). | | |
| 56:11 | 54:55 | 1027. Ll: Three. | | |
| 56:13 | 54:58 | 1028. T: (Hands her pencil to her and points at her work). | | |
| 56:15 | | 1029. Ln: Colour. | | |
| 56:18 | 55:02 | 1030. Ll: (Writes). | | |
| 56:24 | | 1031. T: Yes…yes…yes. | | |
| 56:25 | | 1032. Ll: I told you it’s blue! (Continues to write). Oh no! | | |
| 56:44 | | 1033. T: Yes, yes. That’s correct. | | |
| | 55:21 | 1034. Ls: (Calls teacher). | Ls: Lufefe | |
| 56:51 | | 1035. Ll: (Continues to write while teacher and Ln look on). | | |
| 56:57 | | 1036. T: (Points at her work). | | |
| 57:03 | 55:48 | 1037. Ln: It’s six. | | |
| 57:04 | 55:49 | 1038. T: Erase that (pointing). | | |
| 57:04 | 55:49 | 1039. Ln: It’s six. | | |
| 57:05 | 55:50 | 1040. T: Erase that. It’s eight. | | |
| 57:08 | 55:52 | 1041. Ll: (Continues to write) | | |
| 57:08 | 55:52 | 1042. Ln: It’s the same, it’s eight. | | |
| 57:13 | 55:57 | 1043. T: Erase that. | | |
| 57:15 | | 1044. Ln: Write eight. (Leans over the desk to assist). | | |
| 57:20 | 56:06 | 1045. Ll: (Erases her work). | | |
| | 56:15 | 1046. Ln: What smells bad? That smells good, something smells good. | | |
| 57:31 | 56:17 | 1047. T: (Walks over to group A). | | |
| 57:34 | | 1048. Ly: (Response not recorded) | | |
| 57:39 | 56:27 | 1049. T: Wait just a little bit (walks over to group C). | | |
| 57:41 | | 1050. Ly: I don’t understand this. | | |
| 57:46 | | 1051. T: (Looks at their work). Yes, yes. (He points at their work). | | |
| 58:11 | | 1052. Ll: (Raises her page for the teacher to see). | | |
| | |  **Group B’s work.** | | |

| | | | | | |
|---|---|---|---|---|---|
| 58:13 | | 1053. | T: Who is this? (Points at the page). Who is three plus two? | | |
| 58:19 | | 1054. | Ll: Eight. | | |
| 58:19 | | 1055. | T: Three plus two? | | |
| 58:19 | | 1056. | Ln: Yellow, yellow. | | |
| 58:21 | | 1057. | T: What is three plus two? | | |
| 58:22 | | 1058. | Ln: Five. | | |
| 58:22 | | 1059. | Ll: (Seems confused, counts on her fingers). | | |
| 58:24 | | 1060. | Ln: You are wrong. It's five. | | |
| 58:30 | | 1061. | Ll: I'm not listening to you. Get me an eraser. | | |
| 58:32 | | 1062. | Ln: (Gets up to ask Lp for an eraser). | | |
| 58:37 | 57:05 | 1063. | Ly: (Tries to get teacher's attention). | | |
| 58:40 | | 1064. | T: Wait, wait. (Walks over to group C). Let me see your work. | | |
| | | |   **Group C's work.** | | |
| 58:54 | | | | | |
| 58:56 | | 1065. | T: What is three plus two? | | |
| 58:58 | | 1066. | Lp: Say that again. | | |
| | 57:24 | 1067. | T: What is three plus two? | | |
| 59:00 | | 1068. | Lp: Five. | | |
| 59:02 | | 1069. | T: Five. | | |
| 59:08 | | 1070. | Lp: (Writes). | | |
| 59:10 | | 1071. | T: (Nods). | | |
| 59:12 | | 1072. | Lv: That should be eight. | | |
| 59:13 | | 1073. | Lp: This? | | |
| 59:14 | | 1074. | Lv and T: Yes. | | |
| 59:17 | | 1075. | Lp: (Continues to write). | | |
| 59:18 | | 1076. | Lp and Lv: (Realise their answer is correct and clap their hands). | | |
| 59:19 | | 1077. | Ll: We're done. | | |
| 59:21 | | 1078. | T: Where's your work? | | |
| | 57:25 | 1079. | Ll: We were finished first. | | |

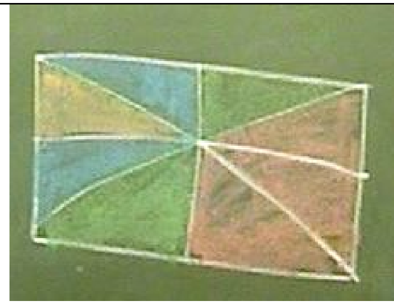
| | | | | |
|---|---|---|---|---|
| | |  **Group B's completed work.** | | |
| 59:22 | | 1080. T: Wait, wait. (Goes to the blackboard and gives group B and C one point each. Group A gets 0). Boys, boys, boys. | | |
| 59:30 | | 1081. Ls: Look at that! | | |
| 59:33 | | 1082. Ly: Just leave it. | | |
| 59:46 | | 1083. T: (Cleans the board). | | |
| 1:00:01 | | 1084. Ly, Ls: (Look out of the window). | | |

**Comments:**

- The learners continued to produce the teacher's procedure in their pairs.

## Evaluative Event 5.2: Example Three: $\frac{3}{8} + \frac{1}{8} = \frac{4}{8}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 1:00:05 | | 1085. T: (Throws something at Ly to get his attention). Look here. Wait, wait, wait. Look here. (He draws a rectangle on the board. Tries to get their attention). Make… Divide it into eight parts. (He divides the rectangle into eight parts). Do you see? There are eight parts. How many are yellow? | | |
| 1:01:07 | | 1086. Ls: Three. | | |
| 1:01:09 | | 1087. T: How many are yellow? | | |
| | | 1088. Ls: (Response not recorded). | | |
| 1:01:11 | | 1089. T: Three. There's nothing here (Refers to chalk). (He colours three parts in red). | | |
| 1:01:52 | 58:29 | 1090. Ls: Four. | | |
| 1:01:52 | | 1091. T: How many? | | |
| | 58:29 | 1092. Lp: Three. | | |
| 1:01:56 | | 1093. T: (Colours two parts in green, two parts in blue and one part in brown). Look. (Tries to get the learners' attention). Stop, stop, stop. Leave that now (To Lv). (To Ln) Wait, wait. Stop, stop. (To Ly) stop, stop. | | |

| | | | | |
|---|---|---|---|---|
| 1:03:19 | | 1094. (Ln continues to draw). | |  A rectangle which is portioned into eight parts |
| 1:03:39 | | 1095. T: (Looks at Ln while she's colouring in). Is she blind? | | |
| 1:03:40 | | 1096. Ll: I don't know. | | |
| 1:03:41 | | 1097. Ln: (Continues to colour in). | | |
| 1:03:53 | | 1098. Lp: I want green. | | |
| 1:03:53 | | 1099. T: Is she blind? Are you blind? (To Ln). | | |
| 1:03:59 | | 1100. Ln: Blind? No. | | |
| 1:04:02 | | 1101. T: Stop that. All of you, Look here. Look here (refers to drawing on board) look on the board. How many are brown? How many? I'm asking all of you. How many are brown? | | |
| 1:04:19 | | 1102. Ln: One. | | |
| 1:04:21 | | 1103. Ls, Ly: One. | | |
| 1:04:23 | | 1104. T: How many are green? | | |
| 1:04:23 | | 1105. Ly, Ls, Ln: Two. | | |
| 1:04:25 | | 1106. T: Two. Blue? | | |
| 1:04:26 | | 1107. Ln, Ls, Ly: Two. | | |
| 1:04:29 | | 1108. T: Red? | | |
| 1:04:29 | | 1109. Ly, Ln: Three. | | |
| 1:04:30 | | 1110. Ls: Four, three. | | |
| 1:04:31 | | 1111. T: Listen now, listen now. How many are red? How many are red? | | |
| | 59:52 | 1112. Lp, Ll: Three. | | |
| | 59:53 | 1113. Lv: Three. | | |
| 1:04:41 | | 1114. T: (Writes 3). Ok. | | |
| | 1:00:02 | 1115. Lp: Three. | | |
| 1:04:44 | | 1116. T: (Draws a line below it). | | $\frac{3}{\ }$ |
| | 1:00:05 | 1117. Lp: Draw a line, plus. | | |
| | 1:00:09 | 1118. Ln, Ll: Two. | | |
| 1:04:46 | | 1119. T: How many are there altogether? | | |
| | 1:00:10 | 1120. Lp, Ll, Lv: Eight. | | |
| 1:04:48 | | 1121. Ln: Eight. | | |
| 1:04:48 | | 1122. Ls: Three. | | |
| 1:04:48 | | 1123. Ly: Five. | | |
| 1:04:48 | | 1124. T: (Looks disbelievingly at Ls and Ly). | | $\frac{3}{8}$ |
| 1:04:49 | | 1125. Ln: It's eight. | | |
| | 1:00:12 | 1126. Lp, Lv, Ll: Eight. | | |
| 1:04:53 | | 1127. T: (Writes 8).Do you understand? Do you understand? Do you understand? | | $\frac{3}{8}$ + |
| 1:05:00 | | 1128. Lv: Two. | | |
| 1:05:01 | | 1129. T: (Writes plus then looks at the learners). | | |
| | 1:00:20 | 1130. Lp: Plus. | | |
| 1:05:04 | | 1131. Lv: Two (Response not on LDVD). | | |
| | 1:00:29 | 1132. Lp: Two in red. | | |
| 1:05:07 | | 1133. T: Plus how many brown? | | |
| | 1:00:33 | 1134. Ln, Lv, Lp, Ll: One. | | |

| | | | | |
|---|---|---|---|---|
| 1:05:10 | | 1135. T: (Tries to get Ly and Ls's attention). | | |
| | 1:00:35 | 1136. Lp, Ln: (To Group A). Look at him. | | |
| 1:05:14 | | 1137. T: You two, how many are brown? | | $\frac{3}{8}+\frac{1}{\ }$ |
| 1:05:15 | | 1138. Ls: Two. | | |
| 1:05:17 | | 1139. T: Brown? | | |
| 1:05:18 | | 1140. Lv, Ln: It's one! | Lv: One. | $\frac{3}{8}+\frac{1}{8}=$ |
| | 1:00:43 | 1141. Lp, Ll, Lv: It's one! | | |
| 1:05:20 | 1:00:44 | 1142. Ly: It's one. | | |
| 1:05:22 | | 1143. T: (Writes 1/). | | |
| | 1:00:47 | 1144. Lp: Draw a line. | | $\frac{3}{8}+\frac{1}{8}=-$ |
| 1:05:25 | | 1145. T: How many are there altogether? | | |
| 1:05:25 | 1:00:50 | 1146. Ln: Two, no, eight. | | |
| | 1:00:50 | 1147. Lp, Ll: Eight. | | |
| 1:05:28 | | 1148. T: (Writes 8 =). | | $\frac{3}{8}+\frac{1}{8}=\frac{\ }{8}$ |
| | 1:00:55 | 1149. Ll, Lp: Draw a line. | | |
| | 1:00:58 | 1150. Lp: Take one six, eight. | | |
| | 1:00:59 | 1151. Ll: Take eight. | | |
| 1:05:34 | 1:00:59 | 1152. Ln: It's nine. | | |
| 1:05:35 | | 1153. T: First… (Draws a line on the board). | | |
| | 1:01:03 | 1154. Lp: Take eight and put it there. | | |
| 1:05:40 | | 1155. T: (Points at where denominator should be).Put it in the centre. | | |
| | 1:01:06 | 1156. Lp, Ln, Ll, Lv: Eight. | | |
| 1:05:43 | | 1157. T: (Writes 8 as the denominator then looks at the learners). | | |
| 1:05:45 | | 1158. Ln: One… plus two. | | |
| | 1:01:10 | 1159. Lp: Three plus three… | | |
| | 1:01:10 | 1160. Ll: It's finished. | | |
| 1:05:46 | | 1161. T: That's finished. | | $\frac{3}{8}+\frac{1}{8}=\frac{3+}{8}$ |
| | 1:01:14 | 1162. Ll: Four. | | |
| 1:05:47 | | 1163. T: (Looks at Ly who is knocking a sharpener against the desk). You are being naughty, you are being naughty. | | |
| 1:05:49 | 1:01:18 | 1164. Ly: Yes. | | |
| 1:05:53 | 1:01:19 | 1165. Ls: Red, red. | | $\frac{3}{8}+\frac{1}{8}=\frac{3+1}{8}=\frac{\ }{8}$ |
| 1:05:53 | | 1166. T: Tell me (Points at where numerator should be). | | |
| 1:05:56 | | 1167. Ly: Yellow, yellow. | | |
| 1:05:57 | | 1168. Ln: Two, one. | | |
| 1:05:59 | | 1169. Ly: Three. | | |
| | 1:01:21 | 1170. Ll, Lv: Four. | | |
| | 1:01:21 | 1171. Lp: Three. (To Lv) It's three, three. | | $\frac{3}{8}+\frac{1}{8}=\frac{3+1}{8}=\frac{4}{8}$ |
| | 1:01:25 | 1172. Lv: No, it's not. | | |
| | 1:01:25 | 1173. Lp: It's three plus. | | |
| | 1:01:25 | 1174. Ly: Three. | | |
| 1:06:00 | | 1175. T: (Writes 3+ and looks at the learners). | | |
| 1:06:03 | 1:01:29 | 1176. Ln: Two. | Lp: Two. | |

| | | | | |
|---|---|---|---|---|
| | 1:01:29 | 1177. Lp: One, two, three. | | |
| 1:06:04 | | 1178. Ls: Plus three. | | |
| | | 1179. Ln: Two, eight. | | |
| 1:06:05 | | 1180. T: (Writes 1= , draws a line with 8 as the denominator). | | |
| 1:06:11 | 1:01:34 | 1181. Ly: Four. | | |
| 1:06:11 | | 1182. Ln: Four, eight. | | |
| 1:06:12 | 1:01:34 | 1183. T: (Points at 3+1). | | |
| 1:06:12 | | 1184. Ln, Ly: Four. | | |
| 1:06:13 | 1:01:35 | 1185. Ls: Three. | | |
| | | 1186. Lp, Lv : Four. | | |
| 1:06:13 | | 1187. T: (Writes 4). | | |
| | | 1188. (Learners start chatting to each other). | | |
| 1:06:20 | | 1189. T: Tries to get their attention). | | |
| 1:06:22 | | 1190. Ln: (Continues to chat). | | |
| 1:06:26 | | 1191. T: (Tries to get Ln's attention. To Ln): Are you deaf and blind? | | |
| 1:06:31 | | 1192. Ly: Give her nought, she is telling lies. Change that (points at scoreboard) and give them nought | | |
| | | 1193. Ll: You are too slow, slow. | | |
| 1:06:33 | | 1194. Ls: Nought, nought. | | |
| | | 1195. Ll: You are too slow, slow, slow. | | |

**Comments:**

- Teacher repeated his procedures for generating fractions and adding fractions with a common denominator.

## Evaluative Event 5.3: Example Four: $\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=\frac{5}{8}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 1:06:36 | 1:01:38 | 1196. T: Wait, wait. All of you… you (Points at Ll). I want to see who is clever. I want to see who is clever now. Do you understand that? (Points at the board). Do you understand it? | | |
| 1:06:53 | 1:01:40 | 1197. Ly: Please sign well because I don't understand. | | |
| 1:06:54 | 1:01:46 | 1198. T: Listen, listen. Quickly, quickly. | | |
| | 1:01:47 | 1199. Lv: Quickly, quickly. | | |
| | 1:01:53 | 1200. Lp: Must we write that down? (Points at sum on the board). | | |
| 1:07:03 | 1:01:57 | 1201. T: First… move that (Points at something on group B's table). | | |
| | | 1202. Ll and Ln: (Are unsure of what he means). | | |
| 1:07:06 | 1:02:00 | 1203. T: That (Points at their desk). Bring that closer. | | |
| | 1:01:59 | 1204. Lp: Bring your desk closer. | | |
| 1:07:09 | 1:02:02 | 1205. T: First that. That (points at something on Ly's desk). Bring it closer. | | |
| | | 1206. Lp: Your page. We must do the one on the page. | | |
| 1:07:18 | | 1207. T: (Tries to get Ly's attention). You must do this (Points at his page). First add green. | | |

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|---|---|---|---|---|
| | | First, first, first… | | |
| | | 1208. Lp: Must I write it here? The green? | | |
| 1:07:31 | 1:02:12 | 1209. T: First green. Yes, Write it down. (Goes to Ly). Write it here. | | |
| 1:07:40 | 1:01:15 | 1210. Ly: Wait, wait. | | |
| 1:07:42 | 1:02:21 | 1211. T: Look at the time. Must we get the video again? Must we do the video again? | | |
| 1:07:44 | 1:02:23 | 1212. Ly: No. | | |
| 1:07:45 | 1:02:23 | 1213. (Ly and Ls laugh). | | |
| 1:07:46 | 1:02:25 | 1214. T: Listen, green. Write down the green. Write the green. Plus… How many altogether? | | |
| | 1:02:26 | 1215. Lp: We finished. | | |
| 1:08:01 | 1:02:30 | 1216. T: Finished? Plus, plus blue. | | |
| | | 1217. Lp: Two. | | |
| 1:08:08 | | 1218. T: Blue. Add the blue. | | |
| | 1:02:44 | 1219. Ll: Blue here (points at the page). | | |
| 1:08:12 | | 1220. T: How many altogether? | | |
| | 1:02:52 | 1221. Lp: Altogether? (Writes). | | |
| 1:08:15 | | 1222. T: Again, again add. | | |
| | | 1223. Ll: Write plus. | | |
| 1:08:17 | | 1224. T: Look here. | | |
| | | 1225. Lp: We are finished. | | |
| 1:08:19 | 1:02:58 | 1226. T: Add the red, red, red. | | |
| | | 1227. Lp: (Shows the teacher her work). | | |
| 1:08:26 | 1:03:00 | 1228. T: No, no. Add it. | | |
| 1:08:27 | | 1229. Ly: How many red? | | |
| 1:08:29 | 1:03:03 | 1230. T: You tell me first. | | |
| 1:08:31 | | 1231. Ly: Three red? | | |
| 1:08:32 | 1:03:04 | 1232. T: (Looks disbelievingly at Ly). | | |
| 1:08:33 | | 1233. Ls: One. | | |
| 1:08:33 | 1:03:11 | 1234. T: I said… look here, look here (Points at their page) | | |
| 1:08:37 | | 1235. (Ly writes while Ls looks on). | | |
| 1:08:39 | 1:03:15 | 1236. T: (To the others) Are you finished? Finished? | | |
| | | 1237. Lp: Must I write plus? | | |
| 1:08:41 | 1:03:19 | 1238. T: Add the red. | | |
| 1:08:45 | | 1239. Lp: Altogether? | | |
| 1:08:45 | 1:03:21 | 1240. T: The red, altogether, the red. | | |
| | | 1241. Lv: One. | | |
| 1:08:47 | 1:03:25 | 1242. Ll (To group A): We finished, finished. | | |
| 1:08:48 | | 1243. T: Finished (To Group B)? | | |
| | 1:03:28 | 1244. Lp: Is there one red? | | |
| 1:08:49 | | 1245. Ll: No, we need an eraser. | | |
| 1:08:53 | 1:03:32 | 1246. T: (Looks at group A's work).You haven't listened at all. The two of you are not listening. You are playing. | | |
| 1:08:58 | 1:03:34 | 1247. Ly: The problem is you. You keep waving your hands. You must sign better. | | |

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|---|---|---|---|---|
| 1:09:02 | 1:03:34 | 1248. T: I said you must look here (Points at their page). | | |
| | | 1249. Ly: (Complains that he cannot understand the teacher's signing). | | |
| | 1:03:39 | 1250. Ls: (Laughs) | | |
| | 1:03:40 | 1251. Lv: (Calls teacher over) | | |
| 1:09:08 | 1:03:41 | 1252. T: (Looks at their work) Yes, yes. (He goes to group B). Yes. (Looks at their work and points at their page). Yes… What's this? | | |
| 1:09:12 | 1:03:42 | 1253. Ln, Ll: One | | |
| 1:09:13 | 1:03:44 | 1254. T: (Points at their work). | | |
| 1:09:16 | 1:03:47 | 1255. Ln: (Writes). | | |
| 1:09:17 | | 1256. T: Yes. | | |
| 1:09:18 | 1:03:54 | 1257. Lv: (Tries to get teacher's attention). Come look here. | | |
| 1:09:22 | 1:03:57 | 1258. T: (looks at their work). What's that? Erase it. | | |
| 1:09:26 | 1:04:00 | 1259. Lv: Yes, erase it. | | |
| 1:09:27 | 1:04:01 | 1260. Lp: There's no eraser. I'll leave it. | | |
| 1:09:38 | 1:04:00 | 1261. T: (Returns to group B and looks at their work. Looks questioningly at Ll. Points at their page). | | |
| 1:09:43 | 1:04:02 | 1262. Ll: Five. | | |
| 1:09:44 | | 1263. Ln: Five. | | |
| 1:09:45 | 1:04:07 | 1264. T: Yes. | | |
| 1:09:46 | 1:04:08 | 1265. Ln: (Writes). | | |
| 1:09:48 | 1:04:11 | 1266. Lp: (Calls teacher over and shows her work to him). | | |
| 1:09:51 | | 1267. T: Who is it? | | |
| 1:09:51 | 1:04:14 | 1268. Lp: (Points at her work). | | |
| 1:09:54 | 1:04:17 | 1269. T: Yes. | | |
| 1:09:55 | 1:04:21 | 1270. Lp: (Writes then looks at teacher). | | |
| 1:09:59 | | 1271. T: Go and do it over there. (Points at chalkboard). Do it over there. | | |
| 1:10:02 | 1:04:32 | 1272. Lp: On the board? | | |
| 1:10:04 | | 1273. Lv: Must she write it over there? (Refers to chalkboard). | | |
| 1:10:05 | 1:04:38 | 1274. T: (To Lp). You go over there and sign and explain. | | |
| 1:10:11 | | 1275. Lp: Must I explain? | | |
| 1:10:11 | 1:04:40 | 1276. Lv: Go. | | |
| 1:10:12 | 1:04:42 | 1277. Lp: (Gets up and looks at Ll). I must explain. I'm finished (takes her page). | | |
| 1:10:16 | | 1278. Ll: Are you finished? | | |
| 1:10:18 | | 1279. Ln: They finished. | | |
| 1:10:21 | | 1280. Lp: (Chats to group A). | | |
| 1:10:24 | | 1281. Ll: We finished, did you copy again? | | |
| 1:10:25 | 1:04:54 | 1282. T: Quickly, quickly. The time, the time. Look there. Leave that, leave that. Do it the same there (points at the board). Do it the same there. Yes. You (to Ls), look there (points at board). (To Lp) Write it over there. | | |
| 1:10:56 | | 1283. Lp: (Erases previous sum from the board). Must I write here? | | |
| | | 1284. T: Yes. | | |
| 1:11:02 | | 1285. Lp: (Points at the green parts) there are two. | | |
| | | 1286. T: (Response not recorded). | | |

| | | | | |
|---|---|---|---|---|
| 1:11:06 | | 1287. Lp: (Points at green parts) how many are green? | | |
| 1:11:09 | | 1288. Ln: Two. | | |
| 1:11:10 | | 1289. Lp: How many? | | |
| 1:11:10 | | 1290. Ln, Lv: Two. | | |
| 1:11:11 | | 1291. Lp: (To Ll). Uncross your arms. | | $\frac{2}{\ }$ |
| 1:11:12 | | 1292. Ll: Two. | | |
| 1:11:13 | | 1293. Lp: (Writes 2/ ). How many altogether? | | |
| 1:11:17 | | 1294. Lv, Ln: Eight. | | $\frac{2}{8}+$ |
| 1:11:19 | | 1295. Lp: Yes (Writes 8 +). | | |
| 1:11:22 | | 1296. T: (Tells Ly to look at the board). | | |
| 1:11:23 | | 1297. Lp: There are two in blue. How many are there? | | |
| 1:11:26 | | 1298. Ln, Lv: Two. | | |
| 1:11:26 | | 1299. Lp: Hey you (To Ly), how many are blue? | | |
| 1:11:29 | | 1300. Ly: Are you looking at me? | | |
| 1:11:30 | | 1301. Lp: I'm asking you; how many are blue? | | $\frac{2}{8}+\frac{2}{8}$ |
| 1:11:33 | | 1302. Ls, Ly: Two. | | |
| 1:11:34 | | 1303. Lp: (Points at the blue parts of the rectangle). How many? | | |
| 1:11:35 | | 1304. Ly: Two (Swears at Lp). | | |
| 1:11:37 | | 1305. Lp: (Writes 2/ ). How many parts altogether? | | $\frac{2}{8}+\frac{2}{8}+$ |
| 1:11:39 | | 1306. Ln: Eight. | | |
| 1:11:43 | | 1307. Lp: (Writes 8). Must I write plus here (to T)? | | |
| | | 1308. T: (Response not recorded). | | |
| 1:11:45 | | 1309. Lp: (Writes +, then looks at the sum). Must I write one? | | |
| | | 1310. T: (Response not recorded). | | |
| 1:11:53 | | 1311. Lp: (Chats to Ln). | | |
| 1:11:57 | | 1312. Ls: It's two, two, two! | | |
| 1:12:07 | | 1313. Lp: (She is unsure and goes to her desk to check what she has written on the page). | | |
| 1:12:09 | | 1314. Ls, Ly: Now look at that! | | |
| 1:12:13 | | 1315. Lp: (Goes back to the board. Points at the yellow part.) | | |
| 1:12:14 | | 1316. Ly: (Is very upset). | | |
| 1:12:15 | | 1317. Lp: How many are there? | | |
| 1:12:15 | | 1318. Ls: Two. | | |
| 1:12:15 | | 1319. Ln: One. | | |
| 1:12:16 | | 1320. Lp: This (points at the yellow part). How many? | | |
| 1:12:17 | | 1321. Ls: One. | | $\frac{2}{8}+\frac{2}{8}+\frac{1}{\ }$ |
| 1:12:18 | | 1322. Ln: One. | | |
| 1:12:19 | | 1323. Lp: (Looks at the other learners) what do you say? | | |
| 1:12:21 | | 1324. Ly: Eight. | | $\frac{2}{8}+\frac{2}{8}+\frac{1}{8}$ |
| 1:12:22 | | 1325. Ln: One. | | |
| 1:12:24 | | 1326. Lp: One (Writes 1/ ). How many are there altogether? | | $\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=$ |
| 1:12:28 | | 1327. Ln, Ly: Eight. | | |
| 1:12:28 | | 1328. Lp: How many? | | |
| 1:12:29 | | 1329. Ln, Ly: Eight. | | |

| | | | | |
|---|---|---|---|---|
| 1:12:30 | | 1330. Lp: Eight (writes 8). Must I put =? | | |
| | | 1331. T: (Response not recorded). | | |
| 1:12:34 | | 1332. Lp: (Writes =). Must I draw a line? | | |
| | | 1333. T: (Response not recorded). | | $\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=\frac{\phantom{0}}{8}$ |
| 1:12:36 | | 1334. (An announcement is made on the intercom). | | |
| 1:12:37 | | 1335. Lp: (Draws a line and looks at the sum) what must I take? | | |
| 1:12:41 | | 1336. Ln: Five. | | |
| 1:12:42 | | 1337. Lp: (Looks disbelievingly at Ln. Points at all three denominators). How many must I take? | | |
| 1:12:44 | | 1338. Ln: Eight. | | |
| 1:12:45 | | 1339. Ls: Three. | | |
| 1:12:46 | | 1340. Lp: (Writes 8 as the denominator). | | |
| 1:12:48 | | 1341. Ls: Three. | | $\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=\frac{2+2+1}{8}$ |
| 1:12:49 | | 1342. Lp: What comes here (points at space above the line)? | | |
| 1:12:49 | | 1343. Ln: Five. | | |
| 1:12:49 | | 1344. Ly, Ls: Three. | | |
| 1:12:50 | | 1345. Lp: What must I write here? | | |
| 1:12:50 | | 1346. Ln: Five. | | |
| 1:12:52 | | 1347. Lp: (Writes 2+). What comes here? | | |
| 1:12:55 | | 1348. Ly: Two. | | $\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=\frac{2+2+1}{8}\,\frac{5}{\phantom{0}}$ |
| 1:12:56 | | 1349. Lp: (Writes 2+). What comes next to that? | | |
| 1:12:58 | | 1350. Ln: One. | | |
| 1:12:59 | | 1351. Ly: Two. | | $\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=\frac{2+2+1}{8}\,\frac{5}{8}$ |
| 1:12:59 | | 1352. Lp: (Writes 1).That's finished. How much is this? (Points at 2+2+1). | | |
| 1:13:04 | | 1353. Ly, Ln: Five. | | |
| 1:13:05 | | 1354. Ls: Four. | | |
| 1:13:05 | | 1355. Lp: This? (Points at sum again). | | |
| 1:13:06 | | 1356. Ln, Ly: Five. | | |
| 1:13:06 | | 1357. Ls: Four. | | |
| 1:13:07 | | 1358. Lp: (Looks disbelievingly at Ls). No! (Writes 5/ ). What comes here? (Points at where denominator should be). | | |
| 1:13:12 | | 1359. Ln: Eight. | | |
| 1:13:12 | | 1360. Ls: Three. | | |
| 1:13:12 | | 1361. Lp: (Writes 8 then walks away from the board). | | |
| 1:13:18 | | 1362. (Learners are laughing and joking). | | |

**Comments:**

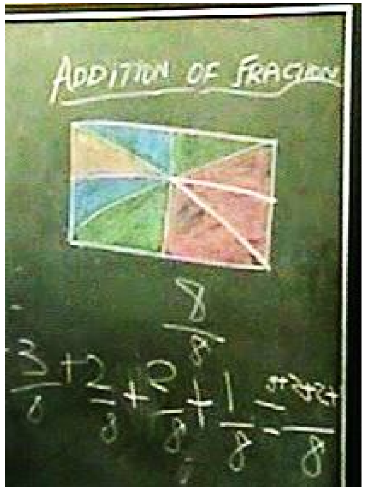
- The learners were instructed to produce the teacher's procedures for generating and adding fractions in their pairs
- One learner is called up to produce the procedures on the chalkboard
- She is able to produce the procedures with assistance from the teacher

## Evaluative Event 5.4: Example Five: $\frac{3}{8} + \frac{2}{8} + \frac{2}{8} + \frac{1}{8} = \frac{8}{8}$

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| 1:13:27 | | 1363. T: (Stands in front and tries to get the learners' attention). All of you come sit closer. | | |
| 1:13:39 | | 1364. (Learners continue to chat and do not pay attention to him). | | |
| 1:13:40 | | 1365. T: Come and sit closer. | | |
| 1:13:56 | | 1366. Ln and Ll: (Turn their desks to face the board). | | |
| 1:14:04 | | 1367. T: (Tries to get their attention). This group is finished (Points at group C). Now, it's this group. | | |
| 1:14:20 | | 1368. Lp: Are we finished? | | |
| 1:14:20 | | 1369. T: Your group is finished. | | |
| 1:14:23 | | 1370. Lp: We are finished (To Lv). Now it's their turn. | | |
| 1:14:25 | | 1371. T: (Points at group B). Now it's your turn to go to the board. It's your turn. | | |
| 1:14:31 | | 1372. (Ll and Ln argue over who should go up). | | |
| 1:14:34 | | 1373. (The other learners continue to their conversations). | | |
| 1:14:35 | | 1374. T: The time, the time. | | |
| 1:14:37 | | 1375. Ln: (Gets up and takes a page from Ly. She sits down again). | | |
| 1:14:45 | | 1376. T: You two, the two of you. | | |
| 1:14:50 | | 1377. Ln: (Continues to chat). | | |
| 1:14:50 | | 1378. T: (Stands in front of her to get her attention). You are finished (To Group C). This group must go to the board. | | |
| 1:14:57 | | 1379. Ll: You go (To Ln). | | |
| 1:15:00 | | 1380. Ln: (Gets up and goes to the board). | | |
| 1:15:07 | | 1381. T: (Erases group C's sum from the board). | | |
| 1:15:20 | | 1382. Ln: How many are green? | | |
| 1:15:21 | | 1383. Ly: (Swears). | | |
| | | 1384. T: (Not recorded). | | |
| 1:15:25 | | 1385. Ln: I must change it. (Looks at the board). How many are blue? | | |
| 1:15:30 | | 1386. Ly: (swears). Two. | | |
| 1:15:34 | | 1387. Ln: Listen to me. How many are blue? | | |
| 1:15:34 | | 1388. Lp: You must first change all of it. Change it to three. | | |
| 1:15:38 | | 1389. Ln: He said I must change it. How many are red? | | |
| 1:15:44 | | 1390. Ly: Three. | | $\frac{3}{\ }$ |
| 1:15:48 | | 1391. Ln: (Writes 3/). How many are there altogether? | | |
| 1:15:54 | | 1392. Ll: Eight. | | $\frac{3}{8} +$ |
| 1:15:57 | | 1393. Ln: (Writes 8 +).How many are blue? | | |
| 1:16:13 | | 1394. Lp: Two. | | $\frac{3}{8} + \frac{2}{\ }$ |
| 1:16:16 | | 1395. Ln: (Writes 2/). | | |
| 1:16:16 | | 1396. Ly: (Complains to the teacher). | | |
| 1:16:20 | | 1397. Ln: How many altogether? | | $\frac{3}{8} + \frac{2}{8}$ |
| 1:16:20 | | 1398. (Learners are laughing and chatting). | | |

| | | | | |
|---|---|---|---|---|
| 1:16:25 | | 1399. Ln: (Writes 8). How many are brown? | | $\frac{3}{8}+\frac{2}{8}\ \frac{1}{8}$ |
| 1:16:30 | | 1400. Ly: One. | | |
| 1:16:30 | | 1401. T: That's good. (Not recorded). | | |
| 1:16:37 | | 1402. Ln: How many are brown? | | |
| 1:16:40 | | 1403. Ls, Ly: One. | | |
| 1:16:45 | | 1404. Ln: (Writes 1/ ) how many altogether? | | |
| | | 1405. (Response not recorded). | | |
| 1:16:49 | | 1406. (Learners are laughing and chatting). | | |
| 1:16:52 | | 1407. Ln: Yes (Writes 8). | | |
| 1:16:53 | | 1408. (The other learners continue to chat and laugh). | | |
| 1:16:59 | | 1409. Ln: How many are green? | | |
| 1:17:02 | | 1410. T: Wait a bit. Is she right? | | |
| 1:17:06 | | 1411. Ly, Ls: She is wrong, she is wrong. | | |
| 1:17:08 | | 1412. Lp: (To Ln) move out of the way. | | |
| 1:17:08 | | 1413. T: is she right? | | |
| 1:17:09 | | 1414. Ly: She is wrong, she is wrong. | | |
| 1:17:11 | | 1415. Lp: There is no green there. | | $\frac{3}{8}+\frac{2}{8}$ |
| 1:17:13 | | 1416. Ln: We had green before. | | |
| 1:17:15 | | 1417. Lp: Before there was blue. It's wrong because there is no green. | | |
| 1:17:17 | | 1418. Ll: There is no green, there is no green. | | |
| 1:17:20 | | 1419. Ln: (Erases 1/8). How many are green? | | $\frac{3}{8}+\frac{2}{8}+$ |
| 1:17:24 | | 1420. Ll: Green again. | | |
| 1:17:24 | | 1421. T: Is equal to. | | |
| 1:17:25 | | 1422. Lp: It's wrong. | | $\frac{3}{8}+\frac{2}{8}$ |
| 1:17:29 | | 1423. Ln: Must I write here? | | |
| 1:17:29 | | 1424. Lp: Plus. | | $\frac{3}{8}+\frac{2}{8}\ 2$ |
| 1:17:31 | | 1425. T: Is equal to. | | |
| 1:17:32 | | 1426. Lp: Is equal to. | | |
| 1:17:33 | | 1427. Ln: (Writes +) | | $\frac{3}{8}+\frac{2}{8}=$ |
| 1:17:35 | | 1428. Lp: No, is equal to. | | |
| 1:17:39 | | 1429. Ln: (Erases +). | | |
| 1:17:41 | | 1430. Lp: Is equal to. | | |
| 1:17:42 | | 1431. Ll: Plus. | | |
| 1:17:44 | | 1432. Ln: (Writes 2). | | $\frac{3}{8}+\frac{2}{8}=\frac{2}{8}$ |
| 1:17:45 | | 1433. Lp: (Jumps up from her seat and goes to the board to help Ln. Erases 2 and writes =. Returns to her desk). I did it here (Points at her work). I saw it. It's is equal to. You don't understand. | | |
| 1:18:00 | | 1434. Ln: How many are green? Listen all of you. | | $\frac{3}{8}+\frac{2}{8}=$ |
| 1:18:06 | | 1435. T: Look at her (to Ls and Ly). | | |
| 1:18:08 | | 1436. Ls: Four. | | |
| 1:18:09 | | 1437. Ln: How many are green? | | |
| 1:18:12 | | 1438. Ls: Four. | | |
| 1:18:12 | | 1439. Ly: Two. | | |

| | | | | |
|---|---|---|---|---|
| 1:18:15 | | 1440. Ln: (Stands at the board). You are wrong. (Seems unsure of what to write). Am I lazy? I'm not lazy. (Writes 2/ ). How many altogether? | | |
| 1:18:44 | | 1441. Ln: (Writes 8). How many are brown? | | |
| 1:18:50 | | 1442. Lv: (Walks up to the board and erases 2/8). Must I write plus? | | |
| 1:19:04 | | 1443. T: Is equal to. | | |
| 1:19:06 | | 1444. Lv: (Writes =). | | $\frac{3}{8}+\frac{2}{8}=\frac{2}{8}$ |
| | | 1445. T: (Not recorded). | | |
| 1:19:09 | | 1446. Lv: Must I write plus? I mean one? | | |
| 1:19:15 | | 1447. T: Come and sit. Let her do it (points at Lp). | | |
| 1:19:18 | | 1448. Lv: (Gets upset and tosses chalk at Lp). | | |
| 1:19:22 | | 1449. (Lv and Ln go back to their seats). | | |
| 1:19:26 | | 1450. Ll: (Tries to get teacher's attention). | | |
| 1:19:27 | | 1451. T: Wait, wait. | | |
| 1:19:30 | | 1452. Lp: (Walks to the board). | | |
| 1:19:36 | | 1453. T: You two, look there (to Ls and Ly). | | |
| 1:19:49 | | 1454. Lp: Listen everybody, listen well. How many are coloured in green? How many are in green? | | |
| 1:20:07 | | 1455. Ly, Ls: Two! | | |
| 1:20:10 | | 1456. Lp: (Writes 2/ ). How many are there altogether? | | |
| 1:20:12 | | 1457. Ln: Eight. | | $\frac{3}{8}+\frac{2}{8}=\frac{2}{8}+\frac{1}{}$ |
| 1:20:14 | | 1458. Lp: Stop sitting like that (to Ls). (Writes 8). And now? | | |
| 1:20:21 | | 1459. Ll: Look at me. | | |
| 1:20:22 | | 1460. Lp: No. | | |
| 1:20:24 | | 1461. Ly: Plus. | | $\frac{3}{8}+\frac{2}{8}=\frac{2}{8}+\frac{1}{8}=$ |
| 1:20:24 | | 1462. Lp: (Writes on the board. Not recorded). | | |
| 1:20:27 | | 1463. Ln: There's no brown. | | |
| 1:20:28 | | 1464. (Learners joke amongst themselves). | | $\frac{3}{8}+\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=$ |
| 1:20:41 | | 1465. Lp: How many are brown? | | |
| 1:20:43 | | 1466. Ln, Ls: One. | | |
| 1:20:44 | | 1467. Lp and Ly: (Have a conversation). | | |
| 1:20:58 | | 1468. Lp: What do you all say? | | |
| 1:21:00 | | 1469. Lv, Ll, Ln: One. | | |
| 1:21:03 | | 1470. Lp: (Writes + 1/ ). How many altogether? | | |
| 1:21:06 | | 1471. Lv: (Raises her hand). | | |
| 1:21:05 | | 1472. Lp: Altogether, how many? (Tries to get Ls and Ly's attention). How many? How many altogether? | | |
| 1:21:10 | | 1473. T: Look at her. | | |
| 1:21:14 | | 1474. Lp: (Writes 8 =). | | |
| 1:21:18 | | 1475. T: (Tells her to erase previously written = sign). It must be a plus. | | |
| 1:21:30 | | 1476. Ll: Plus, plus, plus. | | |
| 1:21:30 | | 1477. Lp: (Erases =). She wrote that (refers to Lv). It's her. | | $\frac{3}{8}+\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=\frac{}{8}$ |
| 1:21:40 | | 1478. Lp: I don't know. (Rewrites the plus sign). Must I draw a long line here? (To teacher). (She draws the line). Why are you sitting like that? Why are you sleeping? Why are you | | |

| | | | | |
|---|---|---|---|---|
| | | sleeping? (Looks at the sum on the board). What must I take and put in the centre? | | $\frac{3}{8}+\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=\frac{3+}{8}$ |
| 1:22:03 | | 1479. Ln: Two. | | |
| 1:22:03 | | 1480. Ll: The centre, eight. | |  |
| 1:22:04 | | 1481. Lp: Oh really? You, you (To Lv). Are you having an attitude? Were you listening? | | |
| 1:22:09 | | 1482. T: (Takes a pencil out of Lv's hand and puts it on her desk). | | |
| 1:22:13 | | 1483. Lp: What comes in the centre? | | |
| 1:22:14 | | 1484. Ll: Eight. | | |
| 1:22:14 | | 1485. Ln: Two. | | |
| 1:22:16 | | 1486. Lp: (Looks at Ln). Oh really? How many in the centre? Hey you (To Ly and Ls). How many in the centre? | | |
| 1:22:21 | | 1487. Ll: Eight. | | |
| 1:22:19 | | 1488. Ln: One plus one. | | |
| 1:22:21 | | 1489. Lp: Look at them, look at them. Copy them. | | |
| 1:22:21 | | 1490. Lv, Ll: Eight. | | |
| 1:22:25 | | 1491. Ln: Eight. | | |
| 1:22:27 | | 1492. Ls: Eight. | | |
| 1:22:28 | | 1493. Lp: (Writes 8 as the denominator). (Question not recorded). | | |
| 1:22:34 | | 1494. Ln: Three. | | |
| 1:22:35 | | 1495. Lv: Three. | | |
| 1:22:42 | | 1496. Lp: (Writes 3+). What? | | |
| 1:22:48 | | 1497. Ls: Four. | | Learner's written work |
| 1:22:50 | | 1498. Lp: (Writes on the board). | | |
| 1:22:52 | | 1499. Ls: Four. | | |
| 1:22:53 | | 1500. Lp: Why are you playing with your hair? You must learn (To Ln). | | |
| 1:22:53 | | 1501. Ls: Four. | | |
| 1:22:57 | | 1502. Ln: Two. | | |
| 1:22:58 | | 1503. Lv: Two, It's two. | | $\frac{3}{8}+\frac{2}{8}+\frac{2}{8}+\frac{1}{8}=\frac{3+2+2+1}{8}=\frac{8}{8}$ |
| 1:23:05 | | 1504. Ln: Five. | | |
| 1:23:07 | | 1505. Lp: (To Ly). What is it? How many? (She writes). | | |
| 1:23:11 | | 1506. Lp: (Writes on the board). There's too little space here. What's better? | | |
| 1:23:17 | | 1507. Ly: Write over there (Points at the board). | | |
| 1:23:17 | | 1508. Lp: Where? You leave that. You can't see anything. (She writes). | | |
| 1:23:20 | | 1509. Lv: (To T) Is it one? | | |
| 1:23:21 | | 1510. T: Yes. | | |
| 1:23:21 | | 1511. Lv: (Tries to get Lp's attention). It's finished. | | |
| 1:23:26 | | 1512. Lp: How many are there? | | |
| 1:23:28 | | 1513. Lv: (Can't see response) | | |
| 1:23:30 | | 1514. Ln: Six, eight. | | |
| 1:23:30 | | 1515. (Bell rings to signal end of period). | | |
| 1:23:35 | | 1516. Lv: Eight. | | |
| 1:23:37 | | 1517. Ll: Eight, eight, eight. | | |
| 1:23:39 | | 1518. Lp: (Writes 8/8). | | |
| 1:23:43 | | 1519. Ly: It's nine. | | |

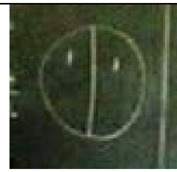
| | | | | |
|---|---|---|---|---|
| 1:23:44 | | 1520. Lp: It's eight! It's three plus two plus two plus one is equal to eight. | | |
| 1:23:54 | | 1521. Ly: Yes, yes. | | |
| 1:23:54 | | 1522. Lp: (Goes back to her seat). | | |
| 1:23:56 | | 1523. (Some learners are chatting). | | |

**<u>Comments:</u>**

- A learner was called up to produce the teacher's procedure for generating and adding fractions. She is able to produce bits of the template
- The previous learner is called up to produce the procedures- she is able to do so with assistance from the teacher.

## Evaluative Event 6: Representing fractions

| TIME | | TRANSLATION OF SIGNING | SPOKEN LANGUAGE | WRITING ON CHALKBOARD |
|---|---|---|---|---|
| T-DVD | L-DVD | | | |
| **1:24:02** | | 1524. T: (Tries to get their attention). All of you, lastly, lastly, lastly…You, lastly. Do you understand? Do you understand? Do you know what all this is? (Points at work on the board). When you think, what do call this? | | |
| 1:24:26 | | 1525. Lp: (Gets up and sits on another seat). | | |
| 1:24:30 | | 1526. T: Sit. When you think, what do you make this? | | |
| 1:24:40 | | 1527. Ln: Dividing into parts. | | |
| | | 1528. Lp: (Response not recorded). | | |
| 1:25:03 | | 1529. Ll: Altogether how many colours are there? How many? We all write on our pages. We think. We are clever. Who knows it and who doesn't. | | |
| 1:25:05 | | 1530. Lp: The work is good. | | |
| 1:25:15 | | 1531. T: What do you say? (To Ln). | | |
| 1:25:16 | | 1532. Lp: (Raises her hand). The work is good and the teacher teaches the learners well. The teacher works well for all the learners. | | |
| 1:25:27 | | 1533. T: Wait, wait, wait. I'm asking. What do you all think…? (Tries to get Ly to attend). You, stand up. Stand up, stand up. | | |
| 1:25:40 | | 1534. Ly: (Gets up). | | |
| 1:25:43 | | 1535. T: When you think and you look at all this, what do you make? | | |
| | | 1536. L: (Response not recorded). | | |
| 1:25:51 | | 1537. T: How many…What is all this? | | |
| 1:25:55 | | 1538. Lv: Raises her hand | | |
| | | 1539. L: (Response not recorded). | | |
| 1:25:55 | | 1540. T: Colours…how many...? Adding… Ok | |  |
| | | 1541. L: (Response not recorded). | | |
| 1:26:10 | | 1542. T: (Writes "Addition of Fraction" on the board). Do you remember this? Do you remember? (T is distracted by his phone ringing). First, we had a circle (He draws a circle on the board). Do you remember? First we had a big cake. Do you remember? We divided it into parts. (He draws a line dividing the cake into two parts). It's half, half. We made two parts. | | The teacher indicates the topic name in writing |
| 1:26:57 | | 1543. Ln: Two | | |

| | | | | |
|---|---|---|---|---|
| 1:26:59 | | 1544. T: (Writes 1 in each part). The whole (writes ½ in each part). It's half, half. Look here (tries to get their attention). All of you, all of you. Then, again (divides the cake into four parts). | |  |
| 1:27:17 | | 1545. Ln: Four. | | |
| 1:27:25 | | 1546. T: How many parts are there altogether? | | |
| 1:27:27 | | 1547. Ls: Two. | | |
| 1:27:26 | | 1548. Ln: Altogether there are four, four altogether. | | |
| 1:27:27 | | 1549. T: How many altogether? | |  |
| 1:27:28 | | 1550. Ln: Altogether there are four. | | |
| 1:27:30 | | 1551. Lv: Four. | | |
| 1:27:31 | | 1552. T: (Writes ¼ in each of the four parts. He divides the cake into six parts). | | |
| 1:27:39 | | 1553. Ln: Altogether there are six parts. | | |
| 1:27:40 | | 1554. T: How many parts altogether? | | |
| 1:27:40 | | 1555. Ln: Six, six. | | |
| 1:27:43 | | 1556. T: Six. (He divides the cake into eight parts). How many are there? | |  |
| 1:27:46 | | 1557. Ln, Lv: Eight. | | |
| 1:27:49 | | 1558. T: When you add all of these, when you add… (His phone rings). When you add all this, when you add the colours, how many? Three? How many have no colour (refers to circle drawn initially). Do you understand? | | |
| 1:28:15 | | 1559. Ln: There are five with no colour | | |
| 1:28:16 | | 1560. T: Listen, listen. Your homework, your homework. I want … (He is interrupted by his phone ringing again). Listen, tomorrow, tomorrow, tomorrow. Your homework. You must all think about this (Points at the rectangle). Think for yourself. (He points at the bread). Think of one of your own. Each one of you must draw your own and think about one yourself. | |  |
| 1:29:05 | | 1561. Ll: All of us must think. Each one of us must draw. | | |
| 1:29:09 | | 1562. T: You must think. | | The teacher portioned a circle into parts to represent fractions |
| 1:29:18 | | 1563. T: Look here (Tries to get Ll and Ln to attend). When you have a problem, come here. I'll start again. Do you understand? If you have a problem… | | |
| 1:29:31 | | 1564. T: Do you have a problem with this work (Points at the board). Are you worried? | | |
| 1:29:37 | | 1565. T: Thank you, thank you, thank you. | | |
| | | **End of lesson** | | |

**Comments**:

- The lesson concluded with the teacher asking the learners what they thought the topic of the lesson was.

**Criteria for representing fractions using objects**:

- Divide an object into parts-the teacher drew a circle which he first divided into two parts.
- It was implicit that the fraction $\frac{1}{2}$ represented one half of the circle.
- He further divided the object into 4 parts. It was implicit that the fraction $\frac{1}{4}$ represented one of the four segments

# Appendix K: Data Production for a Grade Five Lesson on *Time*

## K.1 Overview of the lesson

The focus of this chapter is to describe the production of data for a lesson presented on the topic of *Time*. The lesson was presented to a group of grade five learners by a teacher, referred to as Mrs N, in sign language. The lesson will be analysed using the analytic framework described in Chapter 4 in order to determine *what* gets constituted as mathematics and *how*.

The analysis commenced with segmenting the lesson into evaluative events and sub-events based on the content presented. Table K.1 specifies the duration of the evaluative events and sub-events and provides a description of the type of pedagogic activity that occurred. The duration of the lesson was fifty-nine minutes and one second.

Table K.1 indicates that Mrs N's lesson on *Time* centred on describing the components of the clock and describing the time based on conventions. The lesson focussed on terminology relevant to describing the time based on conventions. Examples of clocks with different times represented on them were used to show the conventional descriptions of time.

## K.2 A note on the signing used by the teacher

Mrs N used signs that refer to people when she referred to objects. She regularly used the sign for "who" when referring to numbers. She also used the signs for "long" and "short" which refer to tall and short people rather than the signs which refer to long and short objects such as the hands of a clock. When referring to the hands of the clock, she used the sign for "stand" which refers to people standing. Mrs N often pointed at numbers and terms written on the board rather than signing them. She could have been unfamiliar with the signs pertaining to the topic such as the signs for *minutes* and *seconds*.

**Table K.1 Evaluative events and sub-events of the lesson on *Time***

| Evaluative Event | Content | Description | Duration | Time |
|---|---|---|---|---|
| 1. | Describing the time using a clock | Expository | 00:02:48 | 00:00:01-00:02:48 |
| 1.1 | The components of a clock | Expository | 00:01:53 | 00:00:01-00:01:53 |
| 1.2 | An example of describing the time: eight o' clock. | Expository | 00:00:54 | 00:01:54-00:02:48 |
| 2. | Describing the relationship between minutes, seconds and hours | Expository | 00:11:51 | 00:02:49-00:14:40 |
| 2.1 | Comparing the terms seconds, minutes and seconds to the hands on a clock | Expository | 00:05:22 | 00:02:49-00:08:11 |
| 2.2 | The number of seconds in a minute and the number of minutes in an hour | Expository | 00:06:28 | 00:08:12-00:14:40 |
| 3. | Describing the time using conventional terminology and the numbers on the clock | Expository | 00:20:41 | 00:14:41-00:35:22 |
| 3.1 | The terms "past" and "to" | Expository | 00:01:11 | 00:14:41-00:15:52 |
| 3.2 | Describing the number of minutes past the hour | Expository | 00:06:43 | 00:15:53-00:22:36 |
| 3.3 | Describing the time using the number of minutes past the hour | Expository | 00:02:43 | 00:22:37-00:25:20 |
| 3.4 | Terminology to describe the time when the minute hand is at three, six, nine and twelve on the clock | Expository | 00:04:31 | 00:25:21-00:29:52 |
| 3.5 | Describing numbers symmetrically opposite each other on the clock | Expository | 00:05:29 | 00:29:53-00:35:22 |
| 4. | Describing the time using examples | Expository | 00:08:36 | 00:35:23-00:43:59 |
| 4.1 | Example 1: Quarter to ten | Expository | 00:04:26 | 00:35:23-00:39:49 |
| 4.2 | Example 2: Three o' clock | Expository | 00:02:19 | 00:39:50-00:42:09 |
| 4.3 | Example 3: Five past two | Expository | 00:01:49 | 00:42:10-00:43:59 |
| 5. | Describing the time when the minute hand changes at five minute intervals past the hour | Expository | 00:15:01 | 00:44:00-00:59:01 |



## K.3 The announcement of the topic

Mrs N introduced the topic name by writing the word *Time* (See Figure K.1) on the chalkboard as well as signing the word. She indicated that the sign for *Time* corresponded to the word written on the board. The learners may have been familiar with the topic, as she indicated that this topic had been taught the previous year. The topic was made explicit in both writing and signing.

### K.4 Production of data and analysis

The analytical framework described in Chapter 4 was used to construct data for the lesson. The data was produced from an examination of the operational activity of the teacher and learners. The criteria generated by the teacher were studied to determine the objects that were made available to the learners. The operations employed over the objects were determined. The next sections will describe the operational activity that occurred during the evaluative events and sub-events during the lesson.

#### K.4.1 Introduction to the topic

During the first evaluative event, Mrs N introduced the topic by drawing a clock on the chalkboard. She filled in the number twelve at the top of the clock, as shown in Figure K.1 and pointed at the space on the clock where the number one is conventionally situated.

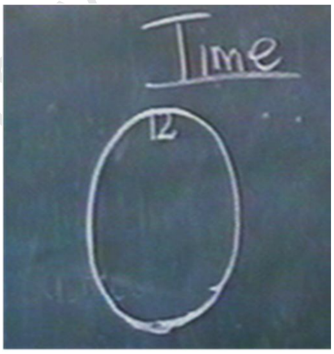



**Figure K.2 Teacher's representation of a clock face**

The learners responded with the numbers from one to eleven which she filled in on the clock as shown in Figure K.2.

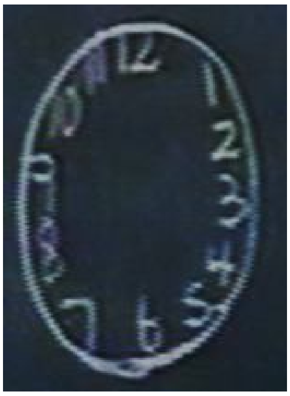



**Figure K.3 A domain of numbers represented on the clock**

Mrs N introduced the components of a clock, comprising of the clock face and a range of numbers from one to twelve. This set $D_1 = \{1,2,3, \dots 12\} \subset \mathbb{N}$ has a specific spatial arrangement on the clock face, as shown in Figure K.2. The clock was introduced solely for the purpose of teaching the learners how to tell time. However, this analogue clock can be used for illustrating the addition and subtraction of hours in mod 12, where $x$ mod 12 = the remainder when dividing $x$ by 12. For example, $5\, mod\, 12 = 5 \div 12 = 0\, remainder\, 5 = 5$ and $12\, mod\, 12 = 12 \div 12 = 1\, remainder\, 0 = 0$. The second example shows that 12 in mod 12 equals zero, therefore one can modify the set $D_1$ to $D_1{}' = \{0,1,2, \dots 11\} \subset \mathbb{N}$ where 12 is replaced with zero. The clock in Figure K.2 can be modified to reflect this new range. Mod can be used to add hours. For example, three hours after 11:00 can be translated to: $11\, mod\, 12 + 3\, mod\, 12 = 14\, mod\, 12 = 1\, remainder\, 2 = 2$. Thus 3 hours after 11:00 is 2:00. The clock can be used to add the hours. Starting at 11, then count three places. The number ended on is 2, which shows that three hours after 11:00 is 2:00. Mrs N did not explain the addition and subtraction of hours in her lesson.

Mrs N then indicated that there were two objects, one “tall” and the other “short”. She demonstrated a ticking movement with her fingers which indicated that the long and short object represented the hands of the clock. The long and short objects were translated as the “hands” of the clock. The teacher explicitly used the clock and its components as a representational system for *Time*.

During evaluative event 1.2, Mrs N produced an example of describing the time by drawing hands on the clock. Figure K.3 indicates that her drawing did not explicitly show the difference between the hands in terms of length.

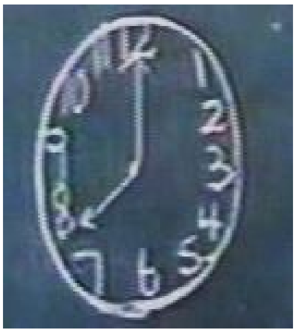



**Figure K.4 An example of describing the time**

The following extract occurred after Mrs N asked the learners to describe the time using the clock drawn in Figure K.3:

40. T[38]: What is the time, time, time[39]?

41. Lp: The short one, the time is eight, half in the afternoon. The time is eight half in the afternoon.

42. Ls: Eight. Time, time, time. To eight.

43. Lt: It stands for the time. Afternoon. Eight, half, eight, afternoon.

44. (A learner is at the door and distracts the learners).

45. T: The long one stands[40] at what?

46. Lp: Twelve.

47. Ls: Twelve.

48. Lt: Twelve.

The learners' responses indicated that they were able to state the numbers at which the hands were pointing but were unable to describe the time using the conventional description of *eight o' clock*. The teacher proceeded to the next evaluative event which focused on producing conventional descriptions for stating the time on a clock.

[38] The letter "T" refers to the teacher's signing or speech.
[39] When signing, the teacher and learners often repeated signs. The transcript is a direct translation of their signing into English.
[40] The teacher's sign is used for a person who "stands".

In summary, the teacher's introduction to the topic explicitly made an association between *Time* and a clock. The components of a clock were explicitly described. Any engagement with the notion of time was absent. The learners were unable to state the time using conventional descriptions for the teacher's given example.

### K.4.2 The relationship between minutes, seconds and hours

The second evaluative event focused on describing the relationship between minutes and seconds and minutes and hours. For evaluative event 2.1, Mrs N made a comparison between the hands on the clock drawn and the terms "seconds", "minutes" and "hour" which she had written on the chalkboard, shown in Figure K.4. She required the learners to match the minute hand (by referring to the hand pointing at twelve on the clock) to the written term "minutes".


**Figure K.5 The terms written on the chalkboard**

The extract indicates that all the learners were not able to produce the required response that the hand pointing at the "12" on the clock represented the minute hand.

52. T: Now, now I want you to choose this (points at hand at twelve on clock). Stands where? (Points at the three words on the board). Where?
53. Ls: Twelve.
54. Lt: H-H-H[41] .
55. Lph: Twelve, M. [*The learner has produced the correct response*][42].

[41] The learner fingerspelled the letter "H" to indicate that she is referring to the word "hour" written on the board. Other learners spelled the letters "S" and "M" to represent the words "seconds" and "minutes". Fingerspelling has been explained in Chapter 1.
[42] Comments regarding the transcript are italicised and inserted in square brackets.

56. Ls: S, M [*Refers to "seconds" and "minutes"*].

57. Lp: S.

58. Lp: (Attempts to fingerspell "minutes").

59. T: The tall one stands where?

60. Lt: Twelve, twelve, twelve.

61. T: (Points at the word "seconds"). Where?

62. Lz: Twelve.

63. T: (Points at "seconds") listen. This (points at "seconds". Shows quick movements with her hands).

64. Lp and Ls: (Imitate teacher).

65. T: (Points at "minutes". Demonstrates a bigger movement).

66. Lp, Lt and Ls: (Imitate teacher's movements).

67. T: (Points at "hour".) Hour.

68. Lp, Lt and Ls: Hour, hour.

The learners responded to the teacher by calling out answers. Three learners correctly responded that the long hand referred to "minutes", however Mrs N did not provide feedback to the learners about their responses. Her criteria regarding the hands of the clock were ambiguous as the speed of the movements she demonstrated did not explicitly show the differences between the hands with respect to representing the terms "minutes", "hours" and "seconds". She took a wall clock to each learner and asked them to point at the second hand by imitating the quick movements made by the second hand on the wall clock and by pointing at the word "seconds" written on the board. The learners were able to identify the second hand on the wall clock. The learners were able to identify the minute hand on the wall clock when she pointed at the word "minutes" written on the chalkboard. It seemed that Mrs N was not clear which hand represented the written word "hour" as shown in the following extract which concluded evaluative event 2.1:

140. T: Hour, hour, hour. Where is it? [*The teacher is referring to the hour hand*].

141. Lt: It's short.

142. Ls: It's thin, hour, hour.

143. Lp: Its long.

144. Lt and Ls: It's long.

145. T: It is long, long. [*The hour hand is the short hand*]. Where is it? Where is it (points at the clock drawn on the board)?

146. Lt: It’s up on top.

147. Lp: Twelve, half.

148. Ls: Twelve, hour, hour, hour.

149. T: It’s this one (points at long hand of the clock drawn on the chalkboard). Hour, hour, hour. Ok. Good.

The extract shows that for Mrs N, the long hand was the hour hand. She possibly associated the long hand with the term “hour” because it travelled 360° on the clock over sixty minutes which made an hour. Mrs N signed “hour” in her exposition but did not use signs for “minutes” and “seconds”. She referred to the terms by pointing at the words on the chalkboard as she may not have been familiar with the signs for these terms.

The objective of evaluative event 2.2 was to describe the number of seconds in a minute and the number of minutes in an hour. Figure K.5 shows Mrs N’s writing on the chalkboard at the start of the event to indicate the units of time.

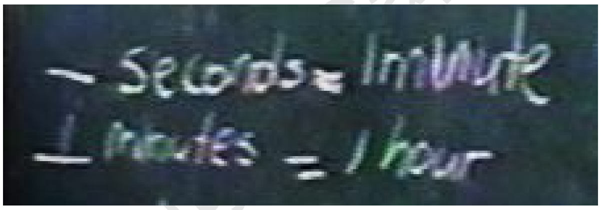



**Figure K.6 The units of time**

Mrs N implicitly indicated that there were intervals between “12” and “1” on the hand-drawn clock by drawing small lines between the two numbers. She did not indicate what the lines represented. In order to exposit that a minute consisted of sixty seconds, she used the wall clock shown in Figure K.6. When the second hand was at “12” on the clock, she started counting as it rotated around the clock face. She counted up to sixty to show that there were sixty seconds in a minute. She indicated in writing that there were sixty minutes in an hour as shown in Figure K.7.

**Figure K.7 The wall clock was used as resource**

Mrs N's criteria regarding the number of units in a minute and an hour were vague as she did not use signs for "minutes", "seconds" and "hours" but referred to the terms by demonstrating movements with her hands. The speed of her movements did not explicitly indicate the difference between the terms which created ambiguity at the level of her signing. For example, her statement that, "The other one is slow and big. The other is slow but small" did not explicitly indicate the difference between the terms "minutes" and "hours". Her criteria were explicitly indicated in her writing as shown in Figure K.7; however the learners may not have understood the meanings of the terms "seconds" and "minutes" due to the ambiguity of her signing. The objects, which were the units of time, were implicit in her criteria.

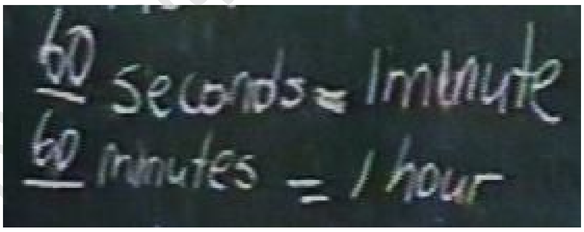



**Figure K.8 The number of units making up a minute and an hour**

In summary, the criteria generated regarding the units of time were unclear as the teacher's signing did not clearly distinguish between the units of "minutes", "seconds" and "hours". The number of seconds in a minute were counted, rather than shown mathematically on the clock. The clock can be described as a base 60 system where at the 60th second, the minute hand completes a move from one minute to the next and at the 60th minute, the hour hand completes a move from one hour to the next. The teacher did not distinguish between these units in her exposition.

### K.4.3 Describing the time using conventional terminology and numbers on the clock

The content of the third evaluative event focused on telling the time using the conventional units of time as well as the numbers on the clock. This evaluative event consisted of five sub-events where Mrs N provided descriptions for telling the time using the position of the minute hand on the clock.

#### K.4.3.1 The terms *past* and *to*

During sub-event 3.1, Mrs N generated the criteria that the clock is divided into a right and left side which represented the terms "past" and "to" respectively as shown in the transcript.

> 214. T: Listen, listen do you remember, remember, remember? (Indicates right half of clock). Wait. (Stands in front of the chalkboard facing learners) Left, left, left is past, past, past. Do you remember?
>
> 215. (Learners repeat past, past, past).
>
> 216. T: Left, left is past, past. What is this side (refers to her right side)? (Indicates left side of clock) What is it? To, to, to, to, ok.
>
> 217. (Learners repeat to, to, to).

The distinction between the left and right sides of the clock was used to report on the time according to the convention that thirty minutes or less past the hour is selected; or twenty-nine minutes or less to the hour is selected, whichever is the case. The teacher did not clarify this convention in her exposition which created confusion later in the lesson.

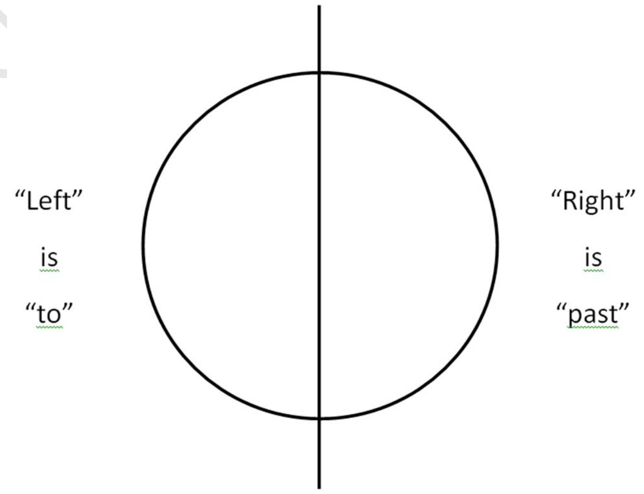



**Figure K.9 The distinction between the two sides of the clock**

Figure K.8 shows Mrs N spatial representation of the terms “past” and “to” using the left and rights sides of the clock. It was implicit that the numbers from 1 to 6 on the “right” side represented the number of minutes “past” the hour, while the numbers 7 to 11 on the “left” side represented the number of minutes to the hour.

**K.4.3.2 Describing the number of minutes past the hour**

When describing the time, it is convention to state the number of minutes either past or to the hour. Mrs N exposited on this convention by mapping a co-domain of numbers, from five to sixty, onto the domain of numbers from one to twelve initially represented on the clock. She mapped the co-domain by asking: “One is the same as who?” She then filled in “5” as shown in Figure K.9. She continued to fill in the numbers up to “60”. The domain and co-domain are represented as: $D_1 = \{1;\ 2;\ 3;\ \ldots;\ 12\}$ and $D_2 = \{5;\ 10;\ 15;\ \ldots;\ 60\}$. It was implicit that $D_2$ represented the number of minutes past the hour. She did not indicate that there were one-minute intervals between the five-minute intervals which she had written. The domain $D_3 = \{0; 1; 2; \ldots; 60\}$ was implied based on her exposition on the units of time in event 2.2, which specified that an hour was comprised of sixty minutes.



Her mapping of the co-domain ($D_2$) is explicitly shown in her writing on the chalkboard as shown in Figure K.9.

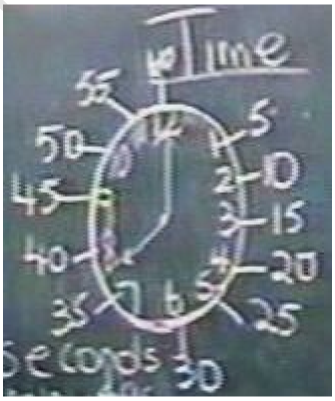



**Figure K.10 The co-domain mapped to the domain**

As shown in Figure K.9, the numbers were mapped as $\{(1;\ 5);\ (2;\ 10);\ (3;\ 15);\ \ldots\}$ where $D_2$ were multiples of five $((n) \rightarrow 5n)$ where $n$ represents the numbers from one to twelve on the clock and $5n$ represents the corresponding minute component of time past the hour. Mrs N did not generate criteria for deriving $D_2$, i.e. that the numbers represented the number of minutes past the hour. She did not state that each number at which the minute hand points, is mapped to two values: the number of minutes *past* the hour and the number of minutes *to* the next hour. The convention is to use these terms in a specific way. For example, the time on the clock in Figure K.10 can be described as *ten past ten* which is the same as *fifty minutes to eleven*.


**Figure K.11 The numbers represent the number of minutes past and to the hour**

### K.4.3.3 Describing the time using the convention of the number of minutes *past* and *to* the hour

Evaluative event 3.3 focused on combining the descriptions generated in events 3.1 and 3.2, i.e. the terms *past* and *to* with $D_2$. The learners were expected to look at the numbers as well as the side of the clock on which it occurred, such as the left or right side. For example, "1" on the clock was read as "five past", "2" as "ten past", "3" as "fifteen past", etc. At "15", Mrs N realised that "fifteen past" was not the common description when stating the time and stated that "Fifteen, fifteen past is right. We'll say it again in a new way, do you hear?" where she anticipated the content of evaluative event 3.4. She described "30" as "thirty past".

At "7" on the clock, Mrs N's criteria collapsed as "7" was on the left side of the clock which was previously described as "to". According to Mrs N's criteria, the time when the minute hand is at "7" on the clock should be read as *thirty five to* which is incorrect. The correct descriptions are either *thirty five minutes past* the hour or *twenty five minutes to* the hour. The learners' responses indicated that they had not acquired the teacher's ambiguous criteria as shown in the extract:

387. T: Ok. Now (points at 35 on the clock).

388. Lt: Seven, half, five.

389. Ls: To, to, to. Thirty five, thirty five, quarter, quarter, to, to.

390. Lod: half, half, half, thirty five, half, thirty five.

391. Lph: Thirty five past, thirty five past. [*This learner's response is the correct description but is incorrect based on the teacher's criteria*].

392. Lol: Thirty five half, thirty five half.

393. Lz: Thirty five to, thirty five to. [*This learner has produced the correct response according to the teacher's criteria but the teacher does not affirm her response as correct*].

394. La: Half…two.

395. Lt: Thirty five.

396. Lan: Half, five.

397. Ls: To, to, to, to. [*This learner correctly uses "to" but does not describe the number*].

398. La: Thirty five to.

399. Lt: Thirty five past, thirty five past.

T: (Looks at Lp) Thirty five past. Okay. [*Mrs N confirms "thirty five past" as the correct response which is incorrect based on her previous criteria*].

By Mrs N reading "7" on the clock as "thirty five past", she showed that she had re-worked her criteria in order to describe the numbers on the left side of the clock, which she had previously described as "to". See Figure K.8. It was implicit that $D_2$ only represented the number of minutes "past" the hour and was not representative of the number of minutes "to" the hour. The extract also shows that learners were encouraged to call out their answers. Mrs N did not provide feedback about incorrect responses but confirmed correct ones. Sixty minutes past the hour was described as "o' clock".

**K.4.3.4 Terminology to describe the time**

The fourth sub-event focused on using different terminology to describe the time when the minute hand was at "3", "6" and "9" on the clock. During sub-event 3.3, Mrs N alluded to saying fifteen past in a "new way". The terms exposited on were "quarter" and "half" as the extract shows:

424. T: Yes, yes. This (points at 15) is fifteen, fifteen. But when you tell the time, you say quarter, quarter. This (points at 15) is who? Quarter, quarter, quarter.

425. Lt, Lph, Lz, Ls: Quarter, quarter, quarter.

426. T: This (points at 30) is half, half, half.
427. Lph: Half.
428. Ls, Lz: Half.
429. T: (Points at 45). It’s the same, do you hear, as quarter, quarter, quarter, quarter.
430. Lt: Past.
431. Ls, Lph: It’s the same.
432. Lz, Lph, Lt, Ls: Quarter, quarter, quarter.

Mrs N exposition indicated the mappings shown in Figure K.11:

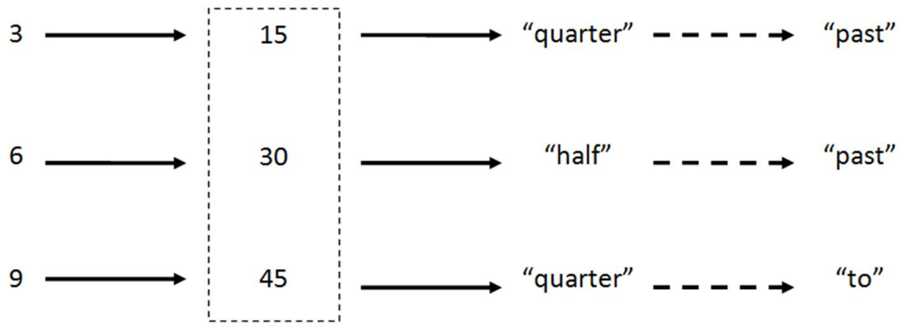



**Figure K.12 The mappings for 3, 6 and 9 on the clock**

The terms “past” and “to” which are conventionally used in conjunction with “quarter” and “half” were implicit as indicated by the broken arrows in Figure K.11. Mrs N did not refer to them in her exposition. Mrs N did not provide an explanation for the terms “quarter” and “half” as being fractions of the number of minutes past or to the hour.

The two mappings applied to the numbers 3, 6 and 9 on the clock caused confusion as shown by these learners’ responses when Mrs N pointed at “15” on the chalkboard:

466. Lp: Fifteen, quarter.
477. Lph: Quarter, fifteen past.
478. Ls: Fifteen past, past.
479. Lt: Fifteen.
480. Lod: Quarter.

Some learners used both description of “quarter” and “fifteen”. One learner responded with the previously accepted response of “fifteen past”. These were not the teacher’s required responses so she re-stated the criterion as, “Throw…fifteen, fifteen throw it. Leave only quarter.” The same criterion applied to describing 6 and 9 on the clock where she stated that the numbers “thirty” and “forty-five” were not to be used in the description, only “half” and “quarter”. As Figure K.11 shows, the mapping of “15”, “30” and “45” onto 3, 6 and 9 was an intermediary step in the teacher's objective of teaching the learners statements about telling the time.

### K.4.3.5 Describing numbers symmetrically opposite each other on the clock

During sub-event 3.5, Mrs N produced another convention for describing the time where the numbers on the clock representing the same number of minutes past and to the hour were equated as shown in Figure K.12.

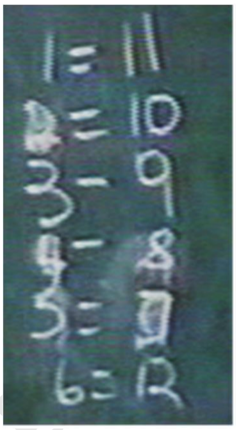



**Figure K.13 Mapping numbers symmetrically opposite each other on the clock**

Mrs N’s mapping is represented in Figure K.13 where the numbers which were symmetrically opposite each other with respect to a line through 12 and 6 were equated.

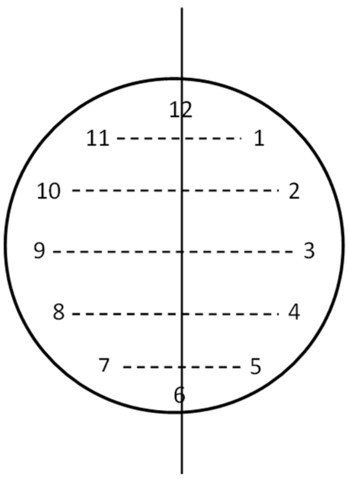



**Figure K.14 Diagrammatic representation showing the mapping**

Her conceptualisation was that the numbers were the same when making statements about the time, not necessarily as being equal mathematically. Fragments of the conventions were the same, i.e. “five past” and “five to” as both statements consisted of “five”. The numbers may have been the “same” as the pairs were equidistant from “12”. Her use of the “=”sign was ambiguous as the sign became a connection between the two numbers, rather than being about equality as shown in the following extract:

629. T: (Points at 4). Four is the same as what?

630. Lph: Quarter, four past.

631. Ls: Quarter past.

632. T: Oh no!

633. Lt: Twenty.

634. T: Twenty, twenty, twenty. Yes. Twenty. The same as eight is the same as who?

635. Lz: Twenty.

636. T: Twenty. [*4 and 8 on the clock have been mapped to twenty*]. (Points at 5). Five is the same as what?

637. Ls, Lt, Lz: Twenty five

T: Twenty five, twenty five, twenty five. It is the same, same, same. Seven is the same as what? Twenty five. [It is not explicit why seven, which was previously thirty five, is now twenty five].

638. Ls, Lz: Twenty five.

639. T: (Points at six). Six is the same as what?

640. Lt: Thirty, thirty, half.

641. Lp, Lph, Ls: Half, half, half.

642. T: Half, half. (Points at 12) Twelve is o’clock, twelve o’ clock.

643. Lt, Lp, Ls, Lph: O’clock.

The numbers 4 and 8 on the clock were mapped to “twenty” which is the number of minutes past and to the hour. Mrs N has restated her criteria as “8” on the clock was previously mapped to “forty”. However, “8” is more conventionally described as “twenty to the hour” rather than “forty minutes past” which is probably why Mrs N has re-worked her criteria. Her focus seemed to be on synonymous terms which signified equal distance from 12 on the clock. Her mappings provided different names for the *place* with respect to the position of the minute hand.

She equated “12” and “6”, however these numbers do not make similar statements about the time. She used different criteria, i.e. a change in axis for mapping these two numbers as they are symmetrical with respect to a line through 3 and 9. It may be the case that she equated “6” and “12” simply because they were the remaining pair of numbers on the clock and all the others pairs were on the same straight line.

As the extract above shows, the terms “past” and “to” were explicit in Mrs N’s exposition about the numbers symmetrically opposite each other. She reminded the learners to consider her spatial descriptions of the left and right side of the clock when telling the time. However, all the learners were not able to accurately tell the time when minute hands pointed as “7” using the teacher’s reworked criteria, as shown in the following extract:

651. T: Remember, remember seven is the same as who?

652. Lt: Thirty five, thirty five. [*Thirty-five was previously mapped to “7”*].

653. Ls: Half, thirty, thirty five.

654. Lph: Twenty five. [*This learner has produced the correct number of minutes to the hour*].

655. Lp: Thirty.

656. T: (Points at Lt). Good, good, good. Remember seven is the same as what? Twenty five, twenty five, twenty five. [*The learner the teacher pointed at, said “thirty-five”*]. Remember, we said five (points at 5 written on board) is the same as twenty five and 7 (points at 7 on board) is also the same as twenty five.

657. Lp: Oh! I was confused. (Points at clock).

658. Lph: I’m confused. [*Learners indicate that they have not acquired the criteria*].

659. T: (Points at 7 on clock). Seven is who?

660. Lt: Thirty five to, to. [*The learner has not acquired the re-worked criteria*].

661. Lph: Twenty five, twenty five past. [*Learner has not acquired the right-left distinction*].

662. Ls: Thirty five, thirty five to.

663. T: Twenty five to, twenty five to. [*Teacher produces the required response as learners are unable to*].

664. Lt: Thirty five to, thirty five to.

665. Lp: Thirty five to. [*These learners continue to produce their previous responses*].

666. Lph, Lz: Twenty five to.

667. T: No, no (to Lt). Twenty five to, twenty five to. [*The teacher corrects their responses without providing a reason*].

668. Lt: Twenty five to.

The extract shows that the re-worked criteria were not acquired by all the learners. Two learners indicated their confusion but were ignored. The learners were unable to produce the required responses as criteria regarding minutes past and minutes to the hour were not explicitly stated.

The number of minutes “past” and “to’ the hour were mapped to the numbers on the clock, as represented in Figure K.14.

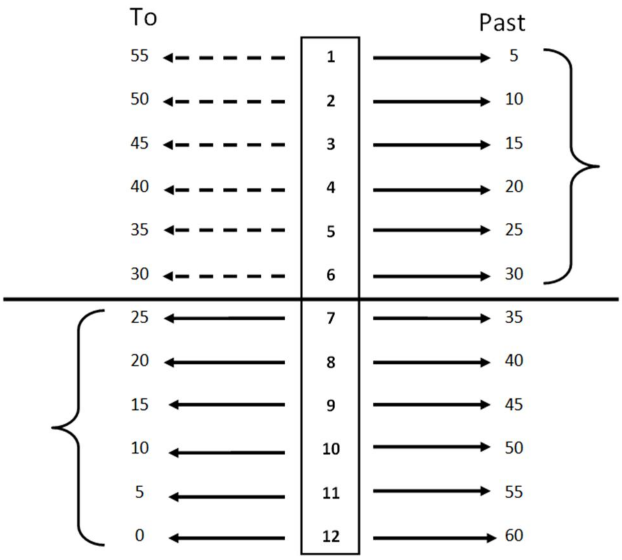



**Figure K.15 Mapping of the number of minutes *past* and *to* the hour**

Figure K.14 shows that the numbers in the domain $D_1 = \{1, 2, 3, \ldots ; 12\}$ were mapped to the number of minutes past and to the hour. Statements about the number of minutes “to” the hour which are conventionally describe “1” to “6” on the clock, were absent as indicated by the broken lines in Figure K.14. Mrs N focused on mapping $D_1$ to the co-domain $D_2 = \{5; 10; 15; \ldots ; 60\}$ which implicitly indicated the number of minutes past the hour. Her re-worked criteria focused on describing the numbers 7 to 12 on the clock based on the number of minutes *to* the hour by equating them to numbers symmetrically opposite with respect to a line through 12 and 6. Mrs N’s exposition focused on describing the time using the mapping shown by the two brackets in Figure K.14.

In summary, the objective of the third evaluative event was to produce statements about the time using conventional descriptions about the number of minutes *to* and *past* the hour. The teacher's criteria were ambiguous and implicit as the numbers on the clock were numerously mapped which created confusion. The clock was spatially described as having a left and right side which were synonymous with the terms "to" and "past" while specific places on the clock were described as "quarter" and "half". At the end of the evaluative event, the learners' responses indicated that they did not acquire the criteria and were not accurately able to tell the time.

### K.4.4 Describing the time using examples of clocks

For the fourth evaluative event, Mrs N produced three clocks on the board and required the learners to describe the time using the conventions exposited on during the lesson. The examples of time represented on the clocks are shown in Figures K.15, K.16 and K.17.

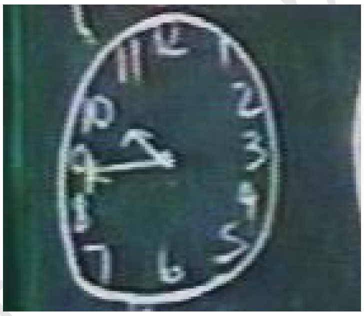


**Figure K.16 Telling the time: Example one**

#### K.4.4.1 Example One: Quarter to ten

The learners were able to read off the numbers which the hands pointed at. They were unable to produce the convention for describing the time when the minute hand was at nine, i.e. quarter to. They guessed at the rules as they had not acquired the implicit and confusing criteria. Crucial aspects of describing the time have remained implicit, such as that the descriptions are based on the position of the minute hand as well as the relation between the minute and hour hands. The learners called out responses until one of them produced the correct response which Mrs N confirmed.

### K.4.4.2 Example Two: Three o'clock

**Figure K.17: Telling the time: Example two**

As Figure K.16 shows, Mrs N's drawing of the clock did not explicitly show the difference between the minute and hour hands which caused confusion. Various learners produced fragments of the description "three o'clock". The class as a collective produced the required response after the learners called out their responses.

### K.4.4.3 Example 3: Five past two



**Figure K.18 Telling the time: Example three**

Similar to the first two examples, the learners called out responses until the required response was produced. Individual learners were not able to state the time on the clocks.

In summary, individual learners were not able to state the times on the clocks in the examples. The learners collectively called out answers with prompting from the teacher. She confirmed the required response and did not provide feedback about incorrect ones.

### K.4.5 Describing the time when minute hand changed and the hour hand remained constant

At the end of evaluative event 4, the teacher realised that the learners were not able to describe the time using the minute and hour hands. Another evaluative event commenced where the learners were required to tell the time on a hand-drawn clock where the minute hand changed at five-minute intervals and moved in a clockwise direction. The hour hand remained constant. Mrs N repeated her criteria which focused on describing the *place* indicated by a number on the clock. The learners were unable to accurately state the time as Mrs N's exposition consisted of fragments which needed to be fit together.

### K.4.6 Summary

The focus of the lesson was on reading a 12-hour analogue time-piece, rather than on the notion of time. Time was constituted as a clock from which statements were generated. Criteria regarding statements about the time were based on fragmentary bits of description which needed to be pieced together. The clock was spatially divided into a left and right side which produced a fragment of the description—the terms *past* and *to*. Specific terms such as "half" and "quarter" needed to be used in the teacher's specified manner when reading off the number from the clock. Numbers were numerously mapped for the purpose of describing the number of minutes *past* and *to* the hour, using conventional descriptions. These mappings were used to produce the required description at a place on the clock, as opposed to the teacher explaining why specific numbers were used to describe the time, i.e. that *twenty past ten* meant that twenty minutes had elapsed since the clock struck ten. Due to the lack of coherence between the fragments, the learners were unable to accurately make statements about the time on a clock.

The teacher's criteria were implicit and often ambiguous. Her criteria did not explicitly describe how a twelve hour analogue time-piece should be read using the minute hand in relation to the hour hand. Her criteria became complicated due to numerous mappings which were not explicitly explained. Her criteria often failed and needed to be re-stated which caused further complications and confusion among the learners.

Ambiguity was also created at the level of her signing where her descriptions of the hands of the clock did not clearly distinguish them from each other. She didn't use signs for terms relevant to the lesson but rather pointed at words written on the chalkboard.

An important feature of Mrs N's pedagogy was that she relied on the class as a whole to produce responses rather than individual learners. Her interaction with the learners encouraged them to call out answers until a correct answer was produced. She did not provide feedback about why responses were incorrect. She did not encourage learners to think about their responses as some of the responses were nonsensical.

# Appendix L: Analyses of Lessons Presented on *Integers*

## L.1 Addition of a positive and negative integer

### L.1.1 Example: $-8 + +4 = -4$

In L1EE4.4, Mrs N needed to restate her criterion for determining the greater number, as shown in the following extract from the transcript:

> 704. T: This (Points at -8) is negative eight and this (Points at +4) is positive four. Now I want to know…listen. An important thing you want to know when we add, add, add you start to look here (Points at number line). (Points at -8) When you add, it is important to look which number is big. When you finished looking… (Looks at Lb). When you finished looking at the number that is big, you take the sign of the number that is big.

The criteria generated in this extract were ambiguous as it was not clear which integer she referred to as the "big" number. Mrs N's previous criterion was that that all positive numbers were "big". Based on her previously stated criteria, the "big" number should have been +4. However Mrs N restated her criteria by covering the symbols with her hands as shown in Figure L.1. In so doing, she demonstrated that the greater number was determined by considering the integers as whole numbers without the symbols of + and $-$. Based on her re-stated criteria, the greater whole number was 8.

**Figure L.1 The teacher indicated that the integers be considered as whole numbers**

The next step was to "take the sign of the number that is big" which indicated that the solution would be a negative integer. The teacher wrote "$-8 + +4 = -$" on the chalkboard. She then subtracted the smaller whole number from the larger one. The difference obtained was coupled to the negative symbol to produce the solution of -4.

Mrs N's shift from the domain of integers to that of natural or whole numbers then back to an integer can be described in a morphism using the absolute value function as shown in Figure L.2. Let $f(x) = |x|$ be the absolute value function.

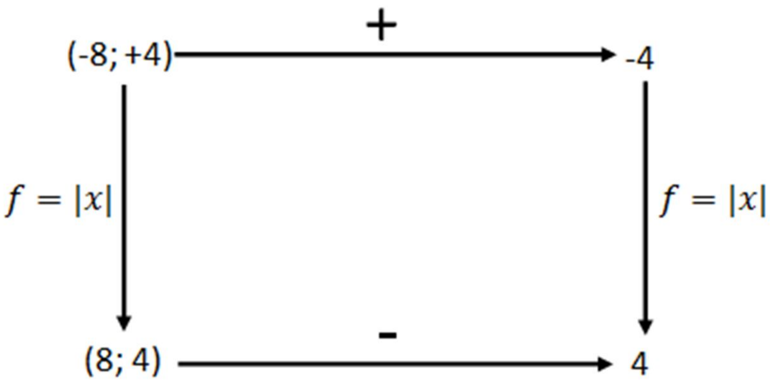



**Figure L.2 A morphism mapping $(\mathbb{Z}, +)$ to $(\mathbb{N}, -)$: -8 + +4 = +4**

For this particular example, an additional function, $g(x) = -x$, is required to map $f(-8) - f(4)$ to $-4$ in order to complete the computation so that the operation of addition on integers corresponds to subtraction of whole numbers. The teacher's steps in the procedure indicate that she treated integers as characters where the numeral and symbol were split up, the smaller whole number was subtracted from the larger one and the solution of the difference was then glued back to the symbol. Figure L.3 shows the teacher's shifts in domain from addition of integers to subtraction of whole numbers, then back to integers using operation-like manipulations.

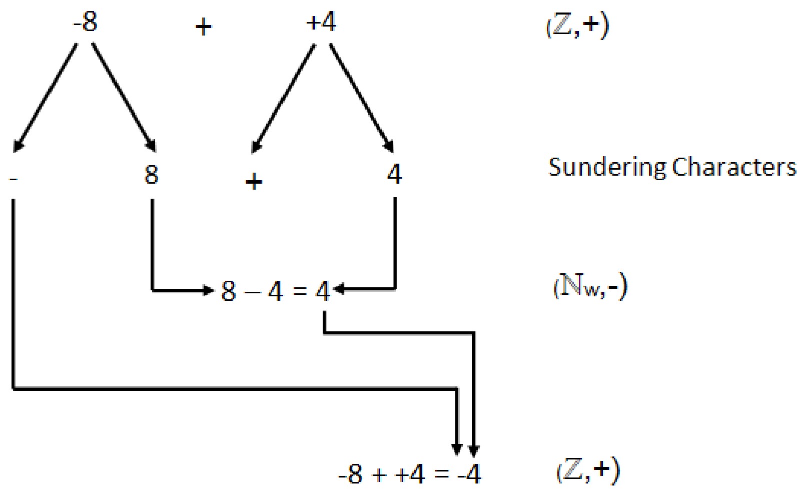



**Figure L.3 A description of a teacher's procedure for adding a negative and positive integer (-8 and +4)**

### L.1.2 Example: $+5\ +-2\ =+3$

Mrs N applied the same procedure to her example in L2EE3.2 where the arguments were +5 and -2. The learners were unable to produce the required solution to the problem so Mrs N repeated the steps in her procedure for redistributing the characters. Figure L.4 shows the shifts in domain inherent in her procedure.

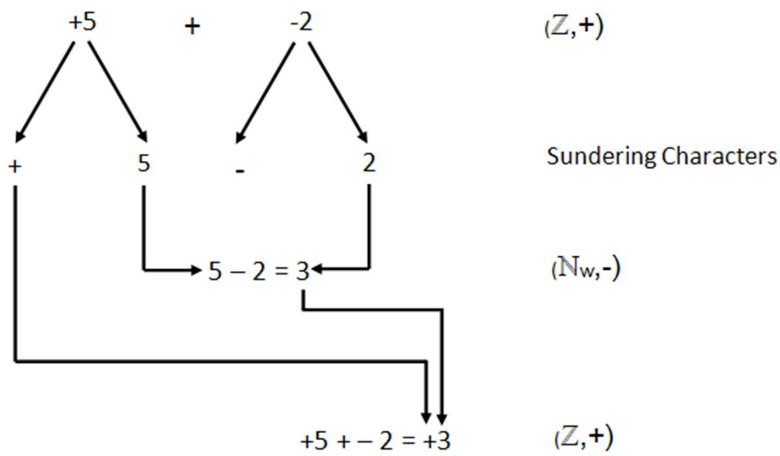



**Figure L.4 A description of a teacher's procedure for adding a positive and negative integer (+5 and -2)**

As Figure L.4 shows, the teacher's procedure for adding a positive and negative integer shifts in domain from adding integers, to subtracting whole numbers, then back to adding integers. The example is explained in the morphism in Figure L.5 using the absolute value function. Let $f(x) = |x|$ be the absolute value function.

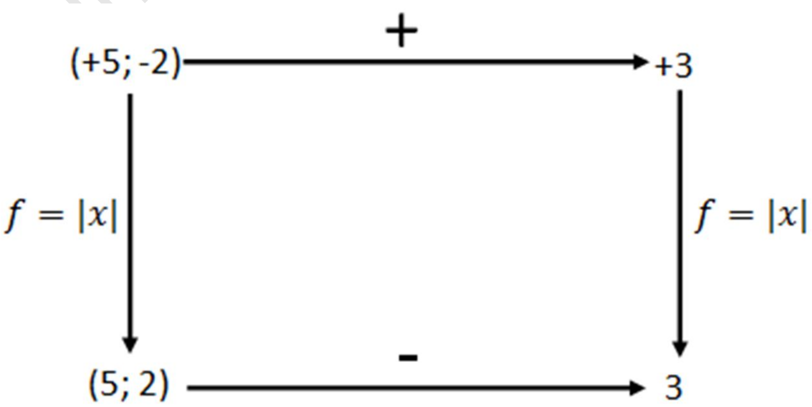



**Figure L.5 A morphism mapping $(\mathbb{Z}, +)$ to $(\mathbb{N}, -)$: +5 + -2 = -3**

For this example, only the absolute value function is required in order to complete the computation.

### L.1.3 Example: $-4 + +6 = +2$

For the last example on addition of integers in L2EE3.4, Mrs N repeated her procedure for adding a positive and negative integer.

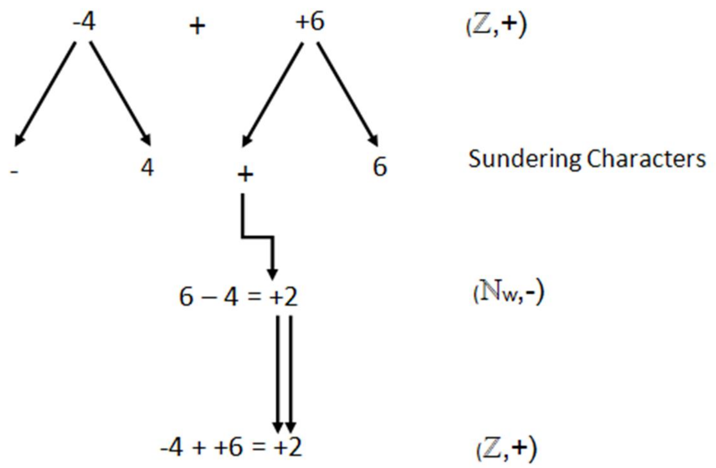



**Figure L.6 A description of a teacher's procedure for adding a negative and positive integer (-4 and +6)**

As Figure L.6 shows, the teacher's procedure effects shifts in domain, from addition of integers, to subtraction of whole numbers, then back to the addition of integers. The morphism for this example is shown in Figure L.7.

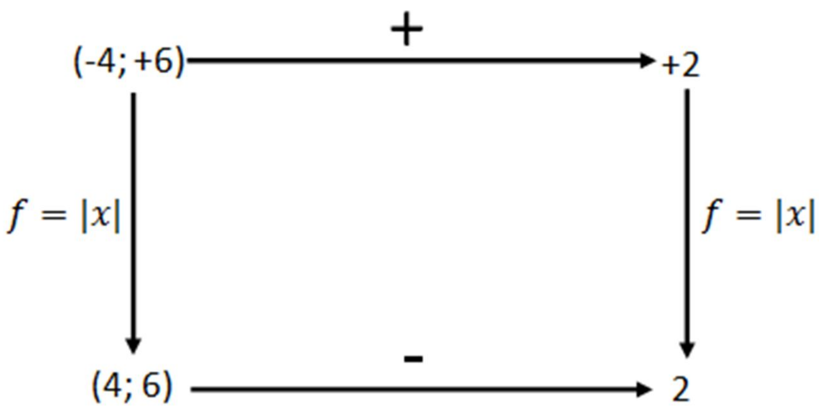



**Figure L.7 A morphism mapping $(\mathbb{Z}, +)$ to $(\mathbb{N}, -)$: -4 + +6 = +2**

To complete the computation, the absolute value function is performed on the integers. The function, $g(x) = -x$ is needed to produce the mapping of $f(-4) - f(6)$ to $-2$ so that the addition of integers corresponds to subtraction of the whole numbers.

**L.2 The use of metaphors**

An important feature of Mrs N's pedagogy was her use of metaphors for the purpose of the learners making sense of new mathematical concepts. An example is shown in the following extract. She called a boy and girl to stand in front of the class.

> 697. T: They are different. What is he? He is a boy. And she? She is a girl. Which means they are different. He will stay… Whether he wears a dress or a pants he stays a? Boy. She (refers to Lv) Now do you see what she's wearing? Pants, but what is she? A girl.
>
> 698. T: She is wearing pants but she will stay what? A girl. Many have pants but they stay a girl. Ok?
>
> 700. T: They are different. Their age is the same but they are different. Their years are the same. Maybe he is thirteen and she is thirteen but they are different because he is a boy and she is a girl.

The teacher's metaphor seemed to be comparing the two learners' genders and their pants to positive and negative symbols and numerals respectively. Their genders render them different, even if they both wear pants. Her metaphor seemed to indicate that the numeral in two integers could be the same but their genders (symbols) make them different. Mrs N's metaphor could be described as ambiguous and confusing and has no relevance to the conceptualisation of the mathematical objects. The use of metaphors like this example seems to further increase the implicit nature of the teacher's criteria in her pedagogic practice.

**L.3 Teacher and learner interaction**

Throughout the lesson, the solutions were produced on the chalkboard subsequent to the learners' calling out answers. The teacher encouraged the learners to call out answers and asked them to "choose" options which encouraged them to guess rather than think about the answer mathematically. She continuously asked learners to validate each other's responses, which further encouraged them to guess. The class collectively produced solutions, and received confirmation of correct responses, but received no feedback on incorrect answers.

When learners called out answers, they produced whole numbers rather than integers as shown in the following extract. The example is ordering -4 and +2. Mrs N asked the learners which was the bigger number:

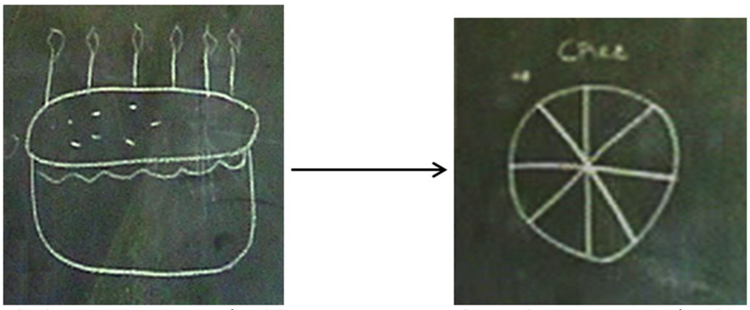
> 118. T: Some say four, others say… Look there are two numbers (points at the board). I want to know which number is big.
> 119. Ln: Four.
> 120. Lz: Two.
> 121. T: She said it's number four. What do you say?

Mrs N did not correct their responses as she probably considered the responses as being partially correct as certain elements of the characters were represented in their responses.

# Appendix M: Analyses of a Lesson on Fractions

### M.1 An example with “cake”

Sub-event 1.3 focused on the idea of a fraction as a piece of cake. Mr L erased the drawing drawn by the learner (See Figure M.1a) and drew a circle which he portioned into eight wedges, the result of which is shown in Figure M.1(b). His drawing made the object more amenable to splitting into parts which was part of his procedure for generating a fraction.




The learner’s representation (a) The teacher’s representation (b)

**Figure M.1 The “cake” which was redrawn to represent a fraction**



Mr L called on a learner to shade three parts of the circle in blue, to demarcate the number of parts to be counted. He presented his procedure for generating a fraction, where counting the shaded parts and the total parts produced the natural numbers 3 and 8. The numbers were spatially distributed in the template as the numerator and the denominator as shown in Figure M.2.

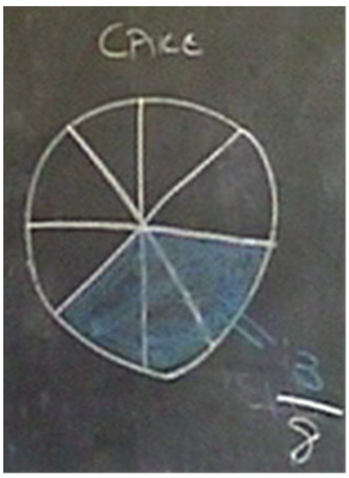



**Figure M.2 Fractional representation using “cake”**

Figure M.2 shows that Mr L wrote the equality sign next to one wedge with the fraction $\frac{3}{8}$, thereby creating ambiguity as it appeared that one wedge was equal to $\frac{3}{8}$. The diagram implicitly showed that the numerator represented the shaded parts as it was written in the same colour as the shaded parts.

Mr L's model for representing the part-whole relation of shaded parts to the whole can be described by the external diagram shown in Figure M.3.

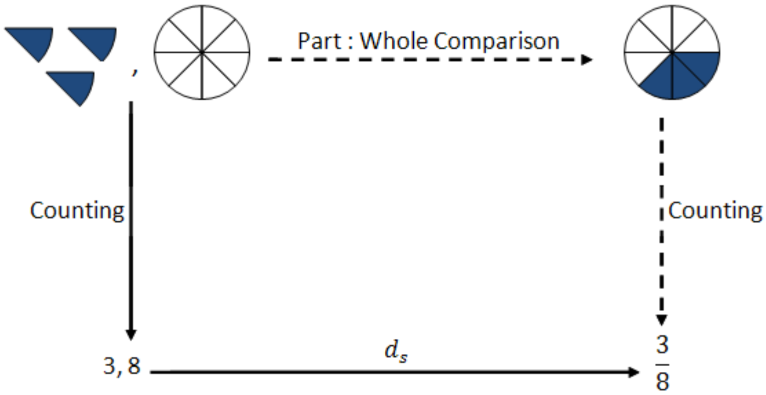



**Figure M.3 A morphism mapping shaded segments of "cake" to a fraction**

The input, consisting of the shaded parts and the total parts; the output which was the graphical representation of proportion as well as the operation "part-whole comparison" was the representing system used to represent the fraction $\frac{3}{8}$. The represented system consisted of the inputs 3 and 8 and the operation of $d_s$. The arguments of the operation were two sets, consisting of three and eight elements respectively. Shading was used to differentiate the smaller set from the bigger set. The operation termed "part: whole comparison" produced the output which was the graphical representation of proportion which showed the part-whole relationship. Again, the example shows Mr L's slippage between discrete and continuous objects in his pedagogy as he used a continuous object, the cake, which he portioned into discrete objects and then counted. Volume was not considered in his explanation. The fraction $\frac{3}{8}$ was produced from the representation of proportion through the function of counting. The path marked by the broken arrows was absent from Mr L's criteria. Mr L's explicit criteria are shown by the path down then across where the elements in the two sets were counted. The operation $d_s$ was performed over the cardinality of the two sets to produce the fraction $\frac{3}{8}$ where "3" was arranged above "8" in the template $\frac{a}{b}$.

## M.2 Addition of fractions

### M.2.1 Exercises in Groups

The pedagogic activity described in the fifth evaluative event was an exercise which the learners had to carry out in pairs. The topic was the addition of fractions with the same denominator. Five worked examples were applied.

#### M.2.1.1 Example one:

For the first example (evaluative event 5.1), the learners were instructed to draw a rectangle, which they were to divide into eight parts. Two parts were to be shaded in blue, three parts in yellow, two in green and one in red. Mr L then instructed the learners to:

> 854. T: Add the yellow. Write it down. The yellow, write it down.

Mr L's instruction did not indicate that the learners were to generate a fraction from the proportion of yellow parts to the whole. It was implicit that he expected them to generate the fraction using his exposited procedure by counting the number of shaded parts and the total number of parts. Subsequent to generating the fraction $\frac{3}{8}$, he expected the learners to add the proportions of the yellow ($\frac{3}{8}$) and blue parts ($\frac{2}{8}$) using his procedure for adding fractions as shown in the transcript:

> 863. T: Add the yellow and the blue.
>
> 869. T: (Goes to the board). Do it the same as this. Remember, remember (points at fractions on the board) it must be the same as this.

At this point, the learners' work had not been recorded but it seemed that they were unable to reproduce the criteria for generating and adding the fractions as exposited by Mr L. They seemed more focussed on colouring in the segments and using different colours. One learner indicated that he had not acquired the criteria, however Mr L did not attempt to assist him. Mr L did another example on the board to repeat his procedure in order to assist the learners.

### M.2.2.2 Example two

Mr L repeated the example in evaluative event 2.2, using the rectangle drawn on the board which he had divided into six segments. He repeated his procedure for generating and adding fractions using the parts shaded in red and blue, as shown in Figure M.4.

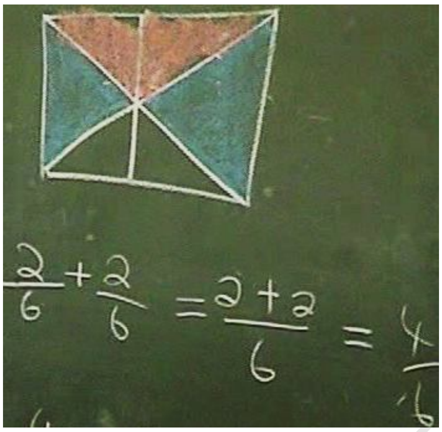



**Figure M.4 Teacher's written work for the addition of fractions**

Figure M.4 shows Mr L's computation on the chalkboard for evaluative event 5.2. He then instructed the learners to apply the same procedure to the example given in evaluative event 5.1.

The first pair of learners wrote: 3+2= __  
__

Their written work indicated that they had not acquired the complete procedure but were able to reproduce certain bits thereof such as the counting of shaded parts represented by the whole numbers 3 and 2. They had conceptualised the requirement of lines but did not acquire the position of the lines in relation to the numbers. They had not conceptualised the denominators as representing the total number of parts in the rectangle. Their written work indicated that this pair had not conceptualised fractions as representative of a part: whole relationship.  They had conceptualised the counting of parts as a whole number calculation. Mr L then proceeded to draw lines below their whole numbers which implicitly indicated that there were parts missing from the template as shown in Figure M.5.

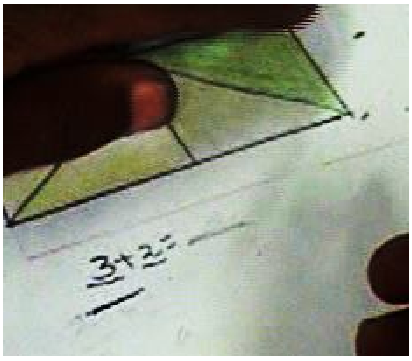


**Figure M.5 Reproduction of the text (1)**

The second pair of learners was able to reproduce the criteria for generating and adding the fractions, however they did not add the numerators correctly indicating that they were either unable to do a simple whole number calculation or they had confused Mr L's criteria for the denominators as "take one" as they have written one of the numerators (3) in the solution. Figure M.6 shows that they wrote $\frac{3+2}{8} = \frac{3}{8}$. They were able to correct their error when it was pointed out by Mr L as shown in Figure M.6.



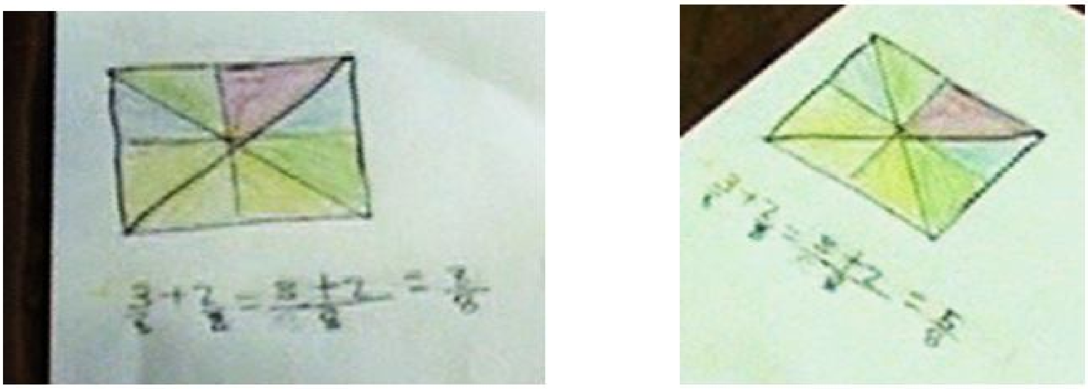


**Figure M.6 Reproduction of the text (2)**

Figure M.7 shows that the third pair of learners was able to reproduce part of the procedure. They completed the procedure with assistance from Mr L.

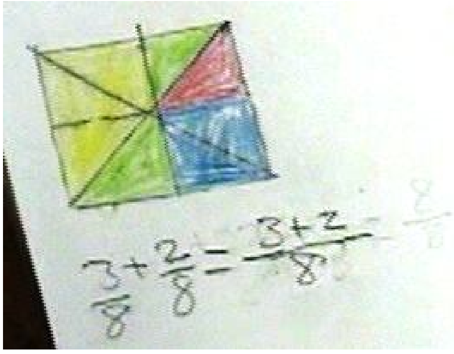



**Figure M.7 Reproduction of the text (3)**

### M.2.2.3 Example three

In evaluative event 5.3 Mr L again exposited his procedure for generating and adding fractions with the same denominator. He drew a rectangle on the chalkboard which he divided into eight parts. He proceeded to shade three parts in red, two parts in green, two parts in blue and one part in brown as shown in Figure M.8.

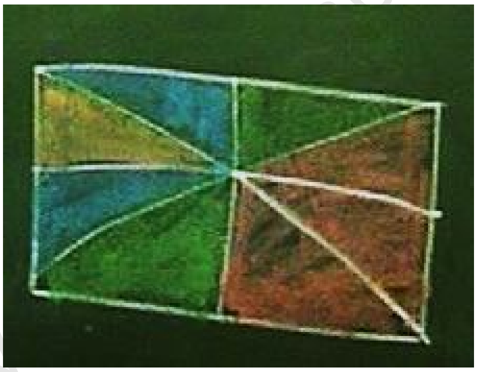


**Figure M.8 A shaded rectangle for the representation and addition of fractions**

He repeated his procedure for generating fractions by counting the number of parts in specific colours and arranging the cardinality as the numerator. The total number of parts was the denominator. His model for generating the fraction $\frac{3}{8}$ and $\frac{1}{8}$ is shown in the external diagrams in Figures M.9 and M.10, respectively. As shown in the diagrams, the part-whole relationship was implicit, while Mr L's criteria more explicitly showed the counting of shaded parts and total parts.

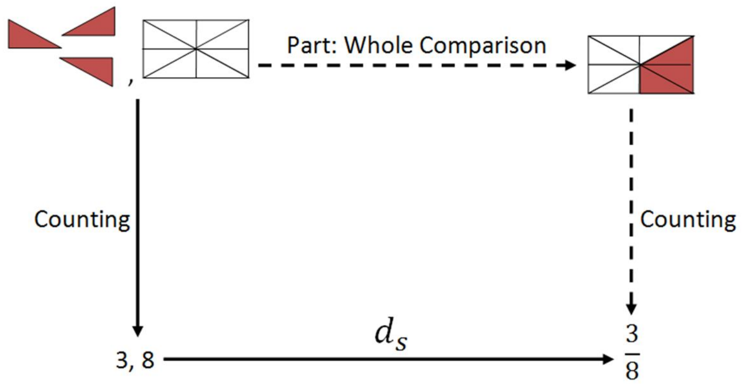



**Figure M.9 A morphism mapping proportion to a fraction: $\frac{3}{8}$**

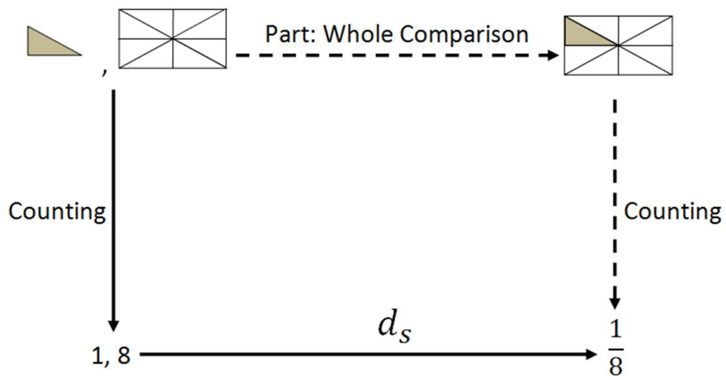



**Figure M.10 A morphism mapping proportion to a fraction: $\frac{1}{8}$**

He then added the fractions generated, using his procedure where characters were arranged in a spatial frame. His mapping for adding the fractions $\frac{3}{8}$ and $\frac{1}{8}$ is represented as a morphism in Figure M.11.

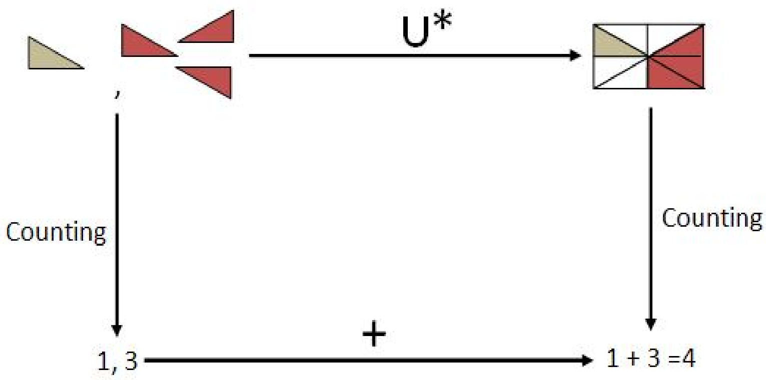



**Figure M.11 A morphism mapping proportion to whole number addition**

Mr L's procedure did not take proportion into account. The cardinality of the two sets represented by the shaded parts was added. Mr L did not exposit of equivalent fractions so he did not indicate that the fraction produced $\frac{4}{8}$ was equivalent to $\frac{1}{2}$.

### M.2.2 Learners produce procedure on the chalkboard

For the last two examples, learners are called up to the chalkboard to reproduce the exposited procedures for generating and adding fractions using the rectangle shown in Figure M.8. The fractions to be added were not specified by Mr L.

#### M.2.2.1 Examples four and five

As the transcript shows, the first learner did not conceptualise the notion of fraction but had acquired bits of the characters which needed to be arranged spatially in the template. Her questions during her reproduction of the procedure indicate that she has conceptualised that the equality sign (=) and a line (—) form part of the template.

1330. Lp: Eight (writes 8). Must I put =?

1332. Lp: (Writes =). Must I draw a line?

The learner needed assistance in order to put the bits in the required positions in the template. She was able to reproduce the procedure with assistance from the teacher. She generated and added the following fractions: $\frac{2}{8} + \frac{2}{8} + \frac{1}{8} = \frac{5}{8}$.

A second learner was not able to reproduce the procedure so the first learner was recalled to produce the procedure. Figure M.12 shows her computation on the chalkboard.

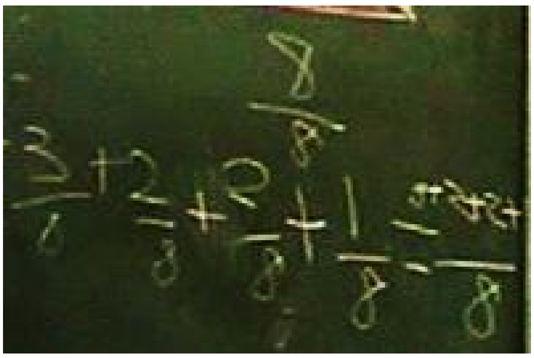


**Figure M.12 A learner's reproduction of the procedure**

Figure M.12 shows that the learner was able to generate four fractions using the shaded segments of the rectangle and was able to add the fractions using the exposited procedure. Her example was $\frac{3}{8} + \frac{2}{8} + \frac{2}{8} + \frac{1}{8} = \frac{8}{8}$. Her solution $\frac{8}{8}$ was written above the generated fractions. Because she had not conceptualised a fraction as a part: whole relationship, she had not simplified $\frac{8}{8}$ to 1.

### M.2.3 Recapping fractional representation

For the last evaluative event, Mr L reviewed fractional representation using a "cake" which he segmented into parts. He portioned the cake into two parts and wrote 1 in each part as shown in Figure M.13.

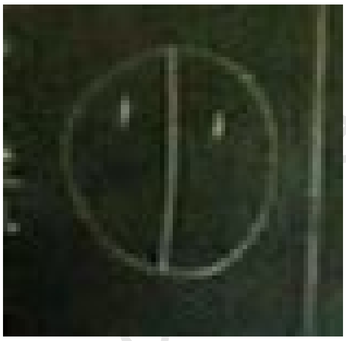


**Figure M.13 Fractional representation using "cake" (1)**

He then wrote $\frac{1}{2}$ in each segment as shown in Figure M.14 and termed it "half".

**Figure M.14 Representing the fraction $\frac{1}{2}$**

His representation is represented as a morphism, shown in Figure M.15.

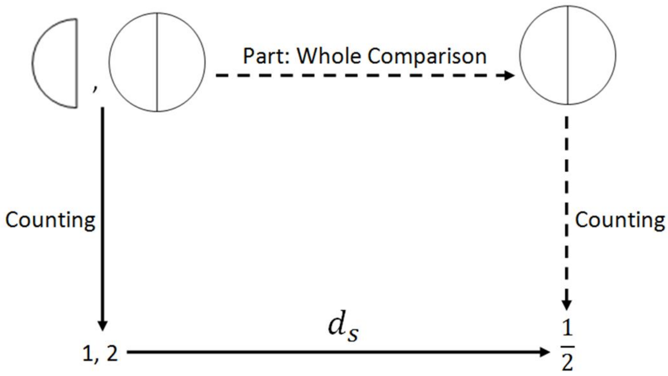



**Figure M.15 A morphism mapping a segment to the fraction $\frac{1}{2}$**

As shown, the graphical representation of the proportion is largely implicit as Mr L focussed on counting the total parts which was represented by the denominator, 2. He proceeded to divide the object into four parts as shown in Figure M.16. The diagram became confusing as he seemed to be dividing the written fraction $\frac{1}{2}$ into two parts so it became unclear as to what the fraction $\frac{1}{2}$ represented.

**Figure M.16 Segmenting the object into four parts**

Mr L asked the learners to count the number of segments and wrote the fraction $\frac{1}{4}$ in each segment. His mapping is represented in Figure M.17 and shows that the proportion of each segment to the whole was implicit. He generated the fraction $\frac{1}{4}$ by counting the total number of parts and spatially distributing the cardinality in the template $\frac{a}{b}$.

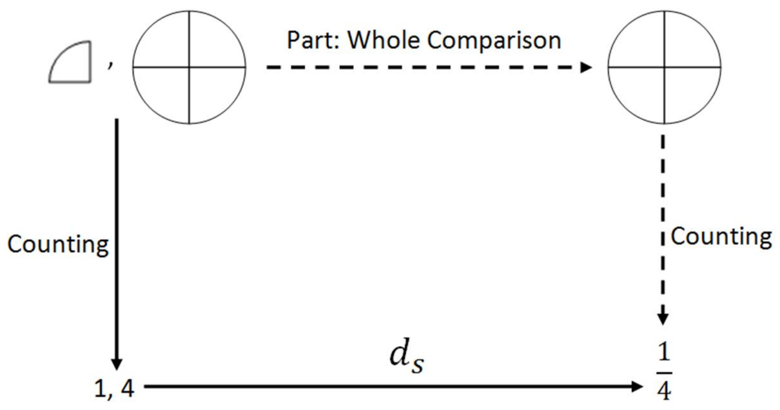



**Figure M.17 A morphism mapping a segment to the fraction $\frac{1}{4}$**

Mr L further divided the object into six then eight parts. He emphasised counting the total number of parts. It was implicit that the total number of parts would be represented by the denominator and one segment would represent the numerator.

Mr L concluded the lesson by instructing the learners to produce their own example of generating and adding fractions based on the procedures he had exposited, as a homework exercise.